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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Improvement of the Ohio River. By ELLWOOD MORRIS, Civ. Eng.

(Continued from page 15.)

II. *Of the Plan of Dams and Locks, or Slackwater Navigation.*

From the data furnished by Mr. Ellet, in his prolific essays, we find that the descent of the Ohio River, exclusive of the 24 feet fall at Louisville, is precisely 400 feet between its head at Pittsburgh and its mouth at Cairo, a distance of 975 miles, or very nearly *an average of* 5 *inches descent to the mile.*

Now, if we suppose the low water surface at Pittsburgh to be raised 5 feet, we have a total of 405 feet *lift*, to be overcome by the successive dams and their locks, necessary to form a slackwater navigation throughout the length of the Ohio River, the Louisville Fall being already surmounted by locks and canals.

With dams lifting 8 feet each, 50 would be necessary.
do. 10 do. 40 do.
do. 15 do. 27 do.

Dams of 15 feet lift seem to have been preferred by some of the advocates of the Slackwater Plan, but no definite proposition upon this point has yet been made; for unlike the Reservoir Plan, the Lock and Dam Navigation appears to have no particular sponsor,* though it has been ably and rather favorably discussed by Herman Haupt, Esq., Civil En-

* See Appendix.

gineer, in a printed pamphlet, entitled "A Consideration of the Plans Proposed for the Improvement of the Ohio River: 1855."

The objections to the plan of improving the Ohio River by means of locks and dams, are both numerous and weighty; they have been grouped by Mr. Ellet, in his usual brief and eloquent manner, in an article published in the Railroad Record of Cincinnati, which we annex to this communication.

There are however *four* of the leading objections to *the Slackwater Plan*, which appear to require more particular notice:

1. That it is not complete within itself, but requires reservoirs as auxiliaries, to enable it to operate with success.
2. That it will cause the river to be much more frequently and longer obstructed by ice, and will render heavy ice freshets both more frequent and more dangerous.
3. That it will increase materially the height of the floods, and injure or destroy a vast amount of private property.
4. That it will be exceedingly costly in its first construction, and after maintenance and operation.

Referring now to these leading points in succession:

1. The experience of the Monongahela navigation shows conclusively the necessity of reservoirs to maintain in dry weather the requisite depth of water in their pools; while Mr. Haupt, in the pamphlet referred to, considers them indispensable to the success, not only of the Slackwater Plan, but of others which he discusses; happily, reservoirs are essential to all the plans that merit examination, and form a common ground on which the advocates of each plan meet.

2. It is well known to those familiar with the Ohio River, that the chief part of the floating ice which first obstructs the navigation, and afterwards closes it by freezing together, comes from the Allegheny; and as the river even now, notwithstanding its continuous current, remains closed some fifteen or twenty days, in every ordinarily hard winter, accompanied by low water, it can hardly be doubted, that if the ice which is incessantly floating down the Allegheny, from the very commencement of cold weather, were received in slackwater pools, (usually low in the cold season, and without much current,) the river would close earlier, open later, and would doubtless remain embargoed by ice, *about two months in a winter.*

Again, this floating ice of the early winter, accumulating gradually in the pools, being carried in fragments from one to another, while in thin cakes, would eventually, as the weather grew colder, freeze therein into a continuous mass of great thickness and solidity; while prior to the breaking up of the more gentle Ohio, the rapid Allegheny would force large quantities of ice into the upper pool, and effectually blockade the port of Pittsburgh; finally, this vast accumulated mass of heavy ice would be torn from its bed in the pools by the first high freshet, and hurled along the valley of the Ohio with a terrible effect, such as has not yet been witnessed, and can hardly be appreciated upon that river.

3. In order to show conclusively that the construction of dams in the Ohio River could not fail to augment the height of floods above the

surface line they would take, if unobstructed by the dams, we refer to the sketch, (Plate II., fig. 5,) showing the actual top-water line of a freshet on the Potomac River, in its passage through the pool of dam No. 5 of the Chesapeake and Ohio Canal, (June 1st, 1836,) obtained at the time from actual levels procured by the writer and his brother engineers, (Joshua Gore and John A. Byers, Esqs., all of us being then engaged in the construction of contiguous divisions of the Chesapeake and Ohio Canal;) through the aid of these gentlemen, simultaneous levels were taken on a line of over 30 miles of the Potomac River, at the time of its maximum rise; Mr. Gore furnishing the levels upon the pool of dam No. 5, which was on his division, while Mr. Byers and the writer continued them up as far as the mouth of the Great Cacapon River, a distance in all of about 32 miles.

This profile of a great river in flood, showing the modification of its surface line produced by a dam of the same altitude as the freshet assumed beyond its influence, that is to say, 18 feet, speaks for itself; and it shows more clearly than any calculation, and with a positive certainty, that by the establishment of similar dams in the Ohio, we must expect, as a necessary consequence, to augment the height of the Ohio River floods, *at least from five to ten feet;* and with the impeded discharge these dams would have in a slackwater navigation, from the others necessarily backing their water against them, there is a strong probability that the augmentation of the floods *would be even greater.*

But no such augmentation is admissible upon the flood waters of the Ohio River, and none such, it is certain, will ever be allowed by the people resident upon its borders, to be produced by obstructions placed in the channel; and this inevitable result alone is adequate to defeat the Slackwater Plan, since happily no power exists either inclined to plan, or able to carry out, such wholesale devastation of private property as would be inseparable from this unwise measure.

It is true, that by reducing the heights of the dams, and largely increasing their number, the injurious effect of these obstructions may be mitigated to some extent, but cannot be removed, except by removing the dams themselves; whilst the great multiplication of the dams, *if low in lift*, would then become a serious evil; for each of these structures will produce certain inevitable delays and difficulties, which, on the whole, would be proportional to their number, and form a serious aggregate.

If it were possible to elongate materially the available breadth of the overfall of the dams, some mitigation of the augmented raise upon the floods might probably be hoped for; but, it is well known, that the Ohio is too uniform in its section to admit of this, except as a specialty, and that it is the river hills alone which at present bound its high water flow. Now, wherever a dam should be erected, heavy guard banks for its preservation would have to be extended to the adjacent hills, and thus cut off a large part of the high water section, now made available by the river, when out of bank, in spreading to the feet of the hills bounding its immediate ravine; and, consequently, the very guard banks necessary to secure the dams on this peculiar river, by reducing the flood water section, and forcing the whole flow channel-wise, would

thus again increase its height in flood, and tend to overcome the benefit of an elongated dam.

But, in point of fact, unless in a few exceptional cases, the transverse breadth necessary to be occupied by the double locks, their guard walls, and the abutments of the dams themselves, would be so considerable—*no less than* 250 *feet*—that, so far from being able to realize an elongated overfall, *the usual case, would be an unduly contracted one.* A remarkable point in the experience of the Monongahela navigation, verifies our Freshet Profile (Fig. 5), in a satisfactory manner, and shows its applicability to these rivers; it is this, that whenever the depth of a freshet on the combs of the Monongahela dams is equal to their lift, (8 feet,) they are always safely passed by steamboats, without using the locks, the dams being fairly drowned out. Now our profile (Fig. 5), shows, that about the point near the head of the pool, where another dam would have been placed to continue a slackwater navigation, the depth from the freshet line to the low water level of the pool is 19 feet, *or just double the depth on the comb.*

Hence we may probably generalize, thus far at least, *that with a series of equal dams of about ten feet lift succeeding each other, in a slackwater navigation upon a river of uniform section, the freshet depth on the comb of one is just half the backwater raise above that level, at the foot of the next;* consequently, whenever the freshet depths of water upon the combs equals the low water lift of the dams, the top water surface of such freshet will present a continuous inclination, or the dams will be drowned out, and passable by boats.

This is confirmed both by our profile upon one river falling two and a-half feet per mile, and by the experience of the Monongahela navigation upon another, with a descent of only 10 inches to the mile), with sufficient closeness for the practical purposes in hand, though the writer is not yet able to say that the law is general.

From the above discussion, another practical consequence flows, that whenever in a slackwater navigation the freshets have a magnitude adequate to drown out the dams, and thus enable boats to pass them by the channel, without using the locks, *the working guards of those locks should equal the low water lift of the dams:* in which case the locks could be used until the depth of water over the dams equalled their lift, when becoming drowned, the boats without loss of time would continue the navigation by the channel, disregarding the dams, and resume in like manner the use of the locks, so soon as the falling water reached a comb depth upon the dams equal to their lift.

But it seems useless to argue this question further; there cannot be a doubt that obstructing the channel of the Ohio River, by the dams of a slackwater navigation, will materially elevate the freshets, while there are many well known cities, towns, and villages, and much other valuable property *within* the scope of the present high-water line, along the borders of this stream, *which cannot stand any addition* to the height of those fearful floods without loss and damage too serious to contemplate.

It may not be inappropriate to state in this connexion, that a few years since, during the prevalence of a considerable freshet, the writer came to the summit of the Ohio River Hill, behind the town of Pomeroy, then

partially submerged, and witnessed the passage down the channel of the well known Steamer *Buckeye State;* the swell created by the boat, immediately floated off their foundations several houses, which had been supposed to be securely fastened by means of ropes. Now had there been a dam below that town, forming (as proposed,) a fine slackwater pool in front of it, that pool raising the freshet water 5 or 10 feet more at that time, *would have almost ruined the place it was intended to benefit and beautify.*

The reflecting reader at this point in the case, might well put the question,—why not control the floods by reservoirs, and use the slackwater also?

The answer to this is brief and decisive: *Reservoirs of a magnitude necessary to control the floods with certainty, are adequate of themselves to maintain the navigation, and render locks and dams unnecessary.**

4. The dams and double locks that would be provided for the Ohio River navigation, were the slackwater plan adopted, ought (it will be admitted), to be constructed in the very best and most substantial manner.

It is an important and most unfavorable fact, that the great works necessary to form a slackwater navigation, worthy of this river and its business, will in almost every instance *have to be founded upon sand or gravel*, as there are few, if any sites where a continuous rock from shore to shore, can be found at a moderate depth in the bed of the Ohio.

While making reasonable allowance for the anticipated difficulties, it is evident that no precise calculations can be made in advance of actual surveys and special plans; nevertheless, the writer has felt emboldened by his long experience upon canals and rivers, to make some rough estimates upon this subject, and thinks he hazards little in the assertion that the probable cost of a substantial slackwater navigation from Pittsburgh to Cairo, 975 miles (excepting the falls), would amount to not less than *twenty-five millions of dollars;* and Mr. Ellet, whose experience upon canals and rivers has been very extensive, has reached the same conclusion. If to this we add the auxiliary reservoirs, deemed necessary to control the floods, the aggregate would not fall short of *thirty-five millions of dollars!*

Even this great sum will not appear large to those Civil Engineers who reflect that such works as would be necessary to control this mighty river—constructed upon the dangerous gravel bottom which forms its usual bed—have never yet been executed in any country.

To bridle, by means of locks and dams, a river, which in its maximum flood rises 31 feet at Pittsburgh, 44 feet at Wheeling, and 63 feet vertical at Cincinnati; upon loose gravel bottom to erect guard walls to out-top such floods, and locks and dams adequate to withstand their fury, aggravated as it will be by vast masses of ice prepared each winter in the pools themselves, is a problem in engineering, the like of which has never yet been solved in any part of the world.

*See page 20 of Mr. Haupt's pamphlet, wherein he proves that reservoirs adequate to have maintained a 6 feet navigation, would have been insufficient to control the floods of the year 1848! And yet proposes reservoirs as *auxiliary* to slackwater, while demonstrating their ability *of themselves*, to have kept the navigation up!

But suppose the work *done*, it would then become indispensable to the prompt dispatch of the great business contemplated to provide and keep in readiness one or more steam-tugs at every lock; to facilitate the passage of huge and clumsy rafts of lumber from the Allegheny—unmanageable coal boats from the Monongahela—or vessels disabled in the vicinity. These added to the necessary attendance at the lock-gates by day and night, the maintenance of lights, the reparation of accidental damages, and the support of the ordinary wear and tear of works of such magnitude, would undoubtedly form a serious annual sum, which it is hardly necessary to speculate upon. Suffice it to say, that (whether added to the interest on the cost of construction or not,) if these annual charges were levied in the shape of tolls at the locks, they would form a grievous burden upon all the business, and could not fail to be utterly destructive of that great coal and lumber trade, which is now so important to Pittsburgh and its vicinity, and to the northern Counties of Pennsylvania.*

We will now annex the able review of the Slackwater Plan, contained in the letter of Charles Ellet, Jr., Esq., Civil Engineer, addressed to Prof. E. D. Mansfield, of Cincinnati, a gentleman of well known scientific attainments, resident for many years upon the banks of the Ohio, and certainly as capable as any one can be of appreciating this great question. That Mr. Ellet's views have secured his approbation, is a matter of importance; because that approbation is of consequence, in the Western States.

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Improvement of the Ohio.† By Charles Ellet, Jr., C. E.

Burnet House,
Cincinnati, April 30, 1856.

Two plans are proposed for the improvement of the navigation of the Ohio River.

The first of these is my own proposition, to form RESERVOIRS on the tributaries of the river, in which water will be collected when the drainage of the country is in excess, and from which the channel will be supplied when the navigation fails, in times of drought.

The other is the plan of LOCKS AND DAMS—the advocates of which propose to construct about fifty dams across the river, to increase the depth of the water, and to place two locks in each dam, to overcome the obstructions created by the dams themselves.

I have recommended the formation of reservoirs on the tributaries of the river, and objected to the construction of these dams across the channel of the river, for the following reasons:

I. After the dams shall have been constructed across the Ohio, it will be found that *they cannot be made water-tight.* The dams will leak, and reservoirs on the tributary streams will be needed in the summer

* It has been generally supposed that reservoirs built upon the main affluents of the Ohio, would necessarily put an end to the lumber business; but such is far from the fact; they can easily be arranged, so as not only to accommodate, *but greatly to facilitate this valuable trade.*

† From the Railroad Record, Cincinnati, Ohio.

season, to supply the pools themselves with sufficient water to float the boats.

This point is illustrated by the slackwater navigation on the Schuylkill River, where *three reservoirs* are now required, and are resorted to annually, to supply water to compensate for the losses resulting from the evaporation, and from the leakage and lockage at the dams.

It is illustrated, also, by many other slackwater improvements; but more particularly by that of the Monongahela River, where, during *the greater part of the summer and fall of* 1854, the water not only ceased to run over the dams, but, by evaporation and leakage, *was almost literally dried out of the pools.*

The Monongahela Company now contemplate resorting to "immense reservoirs," from which a supply can be drawn, in seasons of low water, into their lower pools, and thus keep them in good navigable condition.

They now have a lock and dam improvement, but find that they still need *reservoirs* to supply that improvement with water, and make the dams useful.

Instead of building dams to obstruct the navigation of the Ohio, and locks to overcome the artificial obstructions occasioned by the dams, and reservoirs in the mountains, from which to supply the pools with water, I propose to form the reservoirs in the first instance, and to supply the river itself from them at once, and dispense entirely with the locks and dams. It will require much less water to supply the river in its natural condition, than will be needed to supply it after its channel has been obstructed by leaky dams, and a wider surface has been exposed to the sun and air, and the evaporation thereby increased.

II. *Locks and dams will set a limit to the amount of freight which can be transported on the river.* The plan which I propose—that of supplying the river with water in times of drought—will leave its capacity for conveying freight, for all practical purposes, absolutely unlimited.

After these dams have been built, the number of boats which may traverse the river will no longer be determined by the quantities of produce, minerals, or lumber, that the region of which the Ohio is the great highway, is capable of producing, or which its markets may demand, but *they will be limited to the number that may be passed through the locks.*

The inability of double locks to pass the trade of the Ohio, is fully demonstrated by the Monongahela navigation, where the coal-boats occasionally crowd by *hundreds* to the locks; and, in the haste and anxiety to get through, block up the approaches against all ascending craft, for several days in succession.

There are only five or six steamboats plying on the Monongahela, and requiring the use of its locks; but the improvement of the Ohio, to be tolerated, must be such as may by relied on to accommodate not only the present and prospective coal trade of the Monongahela, but also the lumber trade of the Allegheny; the iron and miscellaneous trade of Pittsburgh; several hundred Ohio River steamboats, and the proper trade of the Ohio River itself. This vast aggregate could not be passed through double locks, even if a set of double locks could always be kept in good working order.

But we cannot hope to have two locks at each of the fifty dams—ex-

posed as they must be to injury from boats and from floods—always in order, unless we provide at least *three locks* in each dam.

III. The delays at the locks will be greater than the running time now required to make the trip; and, consequently, the time now required for every ordinary voyage will be *more than doubled* by the detention at the dams.

If reservoirs are adopted, and water supplied by them to the channel, when it is needed there, the time required to make the trip will be reduced.

IV. If dams are placed across the channel of the Ohio, all the trade of the river, for not less than fifty weeks in every year, will be forced through the locks.

Careful and recorded observations, made at Wheeling, for twelve years in succession, show that the water would not be high enough for boats to go safely over the dams, on an average, fourteen days in the year.

V. If the navigation is improved by reservoirs, no interest can possibly be injured thereby. If the channel is obstructed by dams, the rafting business will be completely destroyed.

VI. Dams on the Ohio, however skilfully they may be planned by the engineer, and however faithfully built by the contractors, will sometimes prove to be imperfect. Resting often on treacherous foundations, some of them will be injured by the ice, and some will be undermined by the floods. This has been the experience wherever numerous dams have been built on the same stream. Such misfortunes have occurred on the Lehigh, on the Schuylkill, on the Potomac, on James River, and on the Monongahela. They may occur also on the Ohio.

When one of the well built dams on the Monongahela gave way, in 1842, the bottom of the river was washed out to a depth of 40 feet. One year was lost in consequence of the continued high water, and when in the second year after the breach was formed, the water fell so that the work of reparation could be commenced, it required *four months* for the most skilful and energetic men to close the gap and secure the dam.

What, I ask, would be the condition of things if one of the fifty dams which it is so lightly proposed to construct on the Ohio, should be washed away, or undermined, and the navigation there suspended for four months?

If we resort to reservoirs for the improvement of the navigation, no damage can result to the trade of the Ohio from a derangement or breach of any part of the works.

VII. Dams will obstruct the navigation, and cause the boats to crowd and jam against the entrance of the locks. These boats will sometimes be sunk—as has happened on the Monongahela improvement, and indeed on every canal in the country—and stop the navigation until they can be removed. A pair of coal-boats will contain a thousand tons, or more; and the removal of so great a mass, from under water, will be a slow and tedious job.

If the river is fed from reservoirs, the channel will be kept always clear, and there can consequently be no jamming of boats. If a boat sinks, there will be room in the channel for other boats to pass by it.

VIII. If locks and dams are adopted, steamboats will sometimes be driven carelessly against the works, and stave in the gates. This occurs

frequently on canals, and has occurred on the Monongahela, though but few steamboats run there. In this one instance, a new pair of gates happened to be ready, and the navigation was restored, by the great skill and energy of the President of the Company, in four days.

If the navigation of the Ohio should be stopped for only *four days*, some seventy or eighty steamboats would collect above and below the locks, and, at some seasons of the year, in that space of time, from 500 to 1000 coal-boats, flat-boats, and rafts, in addition to the steamers, would be arrested there.

The collection, in the space of only a few days, would sometimes be so great on that river, that its whole channel would be filled entirely across, from bank to bank, to the distance of two or three, and, at times, even to the distance of five miles from the locks. On the canals of this country, we have often witnessed such sights, on a smaller scale. In one instance, *seven miles of canal boats* blocked up the entire breadth of the Erie Canal, before the breach which stopped their progress could be repaired. But the boats and locks of a canal are of manageable dimensions, and nearly three hundred boats can be let through a well appointed lock in a day. A pair of coal boats, or a raft, would occupy the huge locks which will be required to pass the Ohio River steamboats, more than an hour. It is indeed very doubtful whether a raft which would fill one of these locks, and cover therefore more than half an acre of surface, could be let through and got out of the way in less than *three hours*. But, assuming that the average time for a pair of coal boats or a raft, would be an hour, to pass five hundred of them through a single lock, working day and night, would consume at least *ten days*, and during that ten days, at certain seasons of the year, as many more would approach and struggle to get through, as the way might be cleared for them. Small, comparatively, as is the present trade of the Monongahela, and rapidly as the smaller locks there required can be worked, the descending coal flats frequently shut off the navigation for ascending steamers on that river, for three or four days in succession.

IX. The cost of the fifty dams and one hundred locks which it is proposed to build on the Ohio, deduced from the ascertained cost of the Monongahela Improvement, with a proper allowance for the increased length of the dams, the increased length, width and height of the locks, and the increased value of labor and materials since that work was completed, twelve years ago, would be about *twenty-five millions of dollars*.

The cost of procuring a five feet navigation by means of *reservoirs* on the tributaries, ought not to exceed *two millions* of dollars.

Is it better to expend twenty-five millions and obstruct the channel of the Ohio by fifty dams, during nine months of the year, when the navigation is perfect, or to pay *two millions* to remove the obstructions caused by low water during three months of drought?

X. Almost every city on the Ohio is built in part on soil subject to be overflowed. The construction of dams below these cities will increase the heights of the floods, and the depths and the frequency of the overflows.

Dams in the mountains may be placed where no valuable property

will be covered by the reservoirs, and they cannot fail, by retaining a portion of the surplus water, to reduce, instead of increasing, the height and destructive power of the floods on the river.

XI. Dams across the Ohio will set the water up into the mouths of all the tributaries, great and small, which empty into its channel. On these tributaries are valuable mills and mill privileges, which will be submerged, even in low water, and destroyed by the dams.

The reservoirs in the mountains will destroy no mills or water power, but, on the contrary, they will create vast and never failing water power wherever the dams which form the reservoirs are placed.

XII. The advocates of locks and dams cannot be opposed to reservoirs, nor deny the practicability of obtaining water enough by that means to feed the Ohio. They cannot take this ground, for every dam they propose to build will form a reservoir of immense size, but one which is not available, because it is in the wrong place. The fifty dams which they propose to raise on the Ohio, will form reservoirs in the river itself, covering, in the aggregate, a space of over *four hundred square miles*, and holding three times as much water as would be needed, if they were placed where they ought to be, in the mountains, to afford a five feet navigation the year round, from Pittsburgh to Cairo.

To avoid forming reservoirs in the mountains, where they will do great good, they propose to make pools in the river, where they will do great harm. These pools in the river will contain fully three times as much water as need be discharged from the mountains to support the navigation throughout the summer. And, after the pools are made in the river, and the navigation has been destroyed by the dams that form them, great reservoirs in the mountains will still be required to supply these pools with water.

Is it not better, I ask, to make the reservoirs in the mountains at once, and dispense with the pools in the river altogether?

XIII. The dams which it is proposed to construct on the Ohio, will convert the channel of that river into fifty stagnant and pestilential ponds, endangering the healthfulness and diminishing the population of its valley.

High dams in the mountains will form deep lakes in the rock-bound gorges. These lakes will be filled with cool water in the winter and spring. This water will retain its coolness until it is needed for the navigation, and then gush forth in refreshing torrents, which will temper the heats of midsummer on the immediate borders of the river.

The locks and dams will destroy the navigation of the river when it is in the best condition, and impair the healthfulness of its shores when they are the least salubrious.

The reservoirs in the mountains will improve the navigation when it most needs improvement, give motion to the river when its waters are stagnant, supply the cities on its banks with a more wholesome beverage, and wash out, as far as fresh water can do that work, the causes of malaria.

I object, therefore, to locks and dams on the Ohio. I object to them, because the river can be improved by a plan which will leave its channel unimpaired and unobstructed; which will improve the navigation

of its tributaries, while it improves that of the river itself; which will tend to diminish the height and destruction produced by the floods, while it increases the depth of the channel in seasons of drought. Which will create immense water power in the mountains, without destroying the water power near the river. Which will pour a healthful current of cool water into the channel from the reservoirs in the mountains, instead of converting its living stream into putrid pools. Which can be used to carry away the ice that obstructs the navigation in the winter, while it overcomes the effect of drought in the summer. Which will improve the health, while it increases the wealth of the country. Which will do some good to every interest, and injure none.

This is the plan which I offer as a substitute for locks and dams on the Ohio.

It is not a speculative plan. It is based on careful measurements of the volume of water flowing down the Ohio, day by day, and every day, for a period of six years. It is the conclusion which results from minute, laborious and appropriate investigations.

This plan, and the facts on which it rests, have been given to the public in a work which has received the approbation and concurrence of scientific minds throughout the country.*

Is it not, then, worthy the attention of that great community of business men which has put the locomotive in motion on the mountain tops, and filled the navigable rivers of the West with magnificent steamers?

I have done my share of the work. I have projected the plan. I have measured the discharge of the river. I have demonstrated the practicability of the scheme, without aid or encouragement, and I ask now only that they who are to be the most benefited by the work shall assist in its execution.

Remarks by Prof. E. D. Mansfield, Editor of the Railroad Record, Cincinnati.

Instead of any elaborate article of our own, we are pleased to give our readers one more valuable, in the foregoing discussion of the Improvement of the Ohio River, by Mr. Charles Ellet, Civil Engineer.

In an early number of *The Record*, we noticed at some length the very able work of Mr. Ellet on the Mississippi and Ohio Rivers. It was one of those accurate and enlightened investigations of a difficult problem in physics, which only an able and well instructed man of science could make. All the *elements* of the Ohio River, such as the quantity, depth, and distribution of water, necessary to the solution of the problem, were carefully ascertained; and the results commended themselves to our mind with the precision and certainty of truth. We thought then, and do now, that Mr. Ellet's plan was not only practical and cheap, but was the only one which promised success. With this conviction, we lay before our readers Mr. Ellet's interesting communication.—*Ed. Rec.*

* See Ellet on the Mississippi and Ohio Rivers.

(To be Continued.)

*On the Mathematical Theory of the Stability of Earthwork and Masonry.**

By W. J. Macquorn Rankine, Esq., C. E., F. R. S.

In the preparation of my course of lectures, I have found it necessary to re-investigate much of the above named branch of mechanics, and I have now a paper in preparation on the subject, which I propose to offer to the Royal Society when it is ready. In the meanwhile, it appears to me that the two fundamental principles on which my researches are based are of such a nature, that they may very properly be communicated to the Royal Society at once. They are as follows:—

I. *Principle of the Stability of Earth.*

At each point in a mass of earth, the directions of greatest and least compressive stress are at right angles to each other; and the condition of stability is, that at each point the ratio of the difference of those stresses to their sum shall not exceed the sine of the angle of natural slope of the earth.

II. *Principle of the Transformation of Structures.*

Let a structure of a given uniform transverse section be stable under a system of forces represented by given lines in the plane of section:—

Fig. 1.

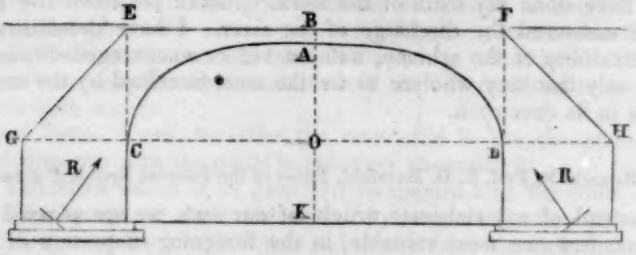
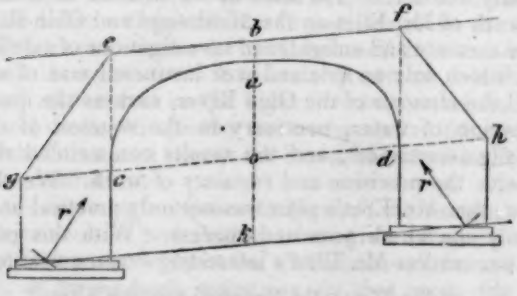


Fig. 2.



Then will any other structure whose transverse section is a *projection by parallel lines* of that of the first structure upon any other plane, be stable

* From the Lond., Edin., and Dub. Mag., December, 1856.

under the system of forces, represented by the projections, upon the new plane, of the lines representing the first system of forces.

Example of the Application of this Principle.

Let fig. 1 be an equilibrated arch with its abutments of the form (for example) proposed by M. Yvon-Villarceaux, suited for a horizontal extrados EF. OK, OA, and AB being given, all the dimensions of the arch and abutments are functions of those three quantities.

It is required to design an arch, fig. 2, for an extrados *e f*, at any given inclination, of any given span *cd* (measured parallel to the extrados), and in which *ok* = OK, *oa* = OA, and *ab* = AB, are the same as in the primitive arch, fig. 1.

Solution. On any vertical plane passing through BK, and not coinciding with the plane of fig. 1, draw *cod* of the given length and inclination, intersecting COD in o. Join cc, D*d*, and project the whole of fig. 1 on the new plane by lines parallel to cc, D*d*. The projection so obtained will be the figure of the arch and abutments required. Moreover, if the lines R, R, fig. 1, represent in length, direction, and position, the resultants of the pressures of the abutments on their foundations in the original arch, then will *r*, *r*, fig. 2, the projections R, R, represent the corresponding resultants in the new arch; and in like manner, the thrust at *a*, is the projection of the thrust at A.

Glasgow, February 18th, 1856.

NOTE. The horizontal foundation courses in fig. 2, do not form part of the projection of fig. 1, but are supposed to be added after the completion of the projection.

For the Journal of the Franklin Institute.

On the proper mode of Constructing an Ice Boat. By A. C. JONES.

Access to and from the Ocean during the winter season being admitted as important to the interests of the Port of Philadelphia, I purpose making some remarks on what has been done, and offering some suggestions for improvement in the mode of keeping open the channel when obstructed by ice.

In 1837, the City had built for that purpose a steam ice-boat, the model of which unfortunately lacked every essential feature fitting it for an ice breaker; no excuse can be pleaded for this mistake, as several years before, the City of Baltimore had an ice boat *in use* which was far better adapted to the breaking of ice; and again, those having its construction must have seen the wherry-boats, which in the winter season were the only means of getting across the river, and noticed the fine form of the bows of those small boats for that purpose: but these guides were unheeded, and the *butting* principle was carried out: that this boat was a failure, no unprejudiced person having witnessed its floundering in the ice will gainsay. Having been some thirteen winters absent, I am not personally cognizant of what the "Philadelphia Ice Boat" did during that time, but last winter after the navigation was closed, and the increased temperature had begun to prepare the way for an open channel, I was attracted to the river at a time when a large steamboat was *very* slowly making her way through the floating ice. I soon found out by the letters

on a large sign that this was the "City Ice Boat," and yet with all these years of experience, the bow unfitted as it was in 1837, remained the same in 1856.* The only marked change I noticed, was, that some ingenious person had with innumerable stays and braces, tried how near to a drum a paddle wheel could be made, and yet retain any propelling powers. "O! but this was done to save the wheel;" admitted; but if the wheel could have been made strong enough, what will become of the shaft and crank? Now, sound engineering could have made the wheels of sufficient strength without impairing their propelling powers, and have prevented them and the shafts or cranks from breakage, (which always happens in the most inopportune time,) by the use of *friction couplings*, so that when the arms met with too much resistance, the wheels might be prevented from breaking by the slipping of the coupling.

I have alluded to the ice boat of Chesapeake Bay. Its bow was formed like the bowl of a table spoon. In 1834 I was aboard of that boat when breaking its way up to Baltimore. The modus operandi was to give headway to the hull, and when the bow struck the edge of the ice, a portion was crumbled down until the slow displacement of the water under the ice caused the bow to rise and run up on the surface, where it would rest for a short time; the weight of the boat finally breaking its way through, the boat was then backed, and the same process repeated.

In this boat the error was in making the curves of the bow too flat, thereby causing a great displacement of the water under the ice, which had principally to flow under the hull before the cohesion of the ice was destroyed. A sharp straight stem, at an angle of about 20°, its cross section of a V shape, would have been much more effective.

At Ports on the Baltic, channels have been frequently sawed out to allow a fleet of vessels to get to sea; this plan, substituting the "ice plough" for the saw, has also been tried in the United States.

Running on the ice and breaking it down; and the Philadelphia plan of *forcing* the way stem on by main strength, are the only methods I am aware of. It has surprised me, that where so much is at stake, experiments with different feasible principles had not been instituted years ago.†

As I know of no direct experiments in ice breaking, I will give from memory some on a small scale made by me twenty-eight years ago. One day watching a farmer ploughing, it struck me that that was the true principle for breaking a channel in the river (having then some connexion with the mercantile interest, I was years before impressed with the importance of keeping the river open during the winter). As soon as it was cold enough I made a series of experiments, (some proved of no practical value,) to test the best way of breaking ice. I carefully sawed out a circular hole in the thin ice covering the water in a tub, and over the whole I placed a narrow piece of board some inches longer than the diameter of the opening. On this board I gently put weights, until the

* I have understood that the bow has been slightly altered since that time. This must be an improvement, for no change could make it worse than it was before.

† I fear that Philadelphia, instead of being foremost, is content to stand still, wearing faded laurels obtained long since; for at the present time, I hear the same *talk* about burning anthracite coal in locomotive boilers, and the *twaddle* against the railroads in the City, &c., that was common some twenty years ago.

surface of the ice became "dished," but not cracked; the weights were then removed; and through a small hole in the centre of the board a cord was passed and its end fastened; the board was then put under the ice so as to have the same position as it had before on the top surface, and the cord was attached to the end of a balance lever of the first order, (its arms being of equal length,) the fulcrum being on the edge of the tub, the same weights were hung to the end of the lever as had been placed on the board; before all these weights had been used the board tore up the ice some distance from the hole.

Next, I made small model boats, the bow of No. 1 having *a vertical stem;* No. 2 *slanting* something like the Baltimore boat; and No. 3, had a bow approximating to a right and left plough placed "land" to "land," the point of the share being below the skim ice; all of these models have the same beam. To the bow was attached a string, each passing horizontally over a pulley placed at a distance, so that the angle would not affect the result, as might have been expected. No. 1 required the most weight to force it through the ice; No. 2 requiring less, and No. 3 taking the *least weight of all.* These experiments were repeated several times without changing the result, and they satisfied my mind that the ploughing or *rooting* principle was the best; but as it may be said, that these trials were on too small a scale to settle a principle, they could be verified, by taking canal boats and having temporary bows fitted to them. Ice of a proper thickness, for an experiment, could always be obtained, by removing a portion of the ice if too thick from a canal, or still water, and allowing new ice to form; a dynamometer would decide the merits of each plan. I have noticed that in ice-breaking with boats, only one method was pursued, whether the ice was solid from shore to shore, or in floating masses, and if the former, they could only work favorably against the tide on account of the fragments clogging the wheels, thus losing much time when the tide did not suit, and also having the current to stem, which reduced the effective power of the boat.

When steamboats have to ascend rapids, or swift running streams, they do not depend altogether on the paddle wheels, for if they did, it would be *one foot ahead, and two back,* but a line is run out ahead and made fast, and the boat is "warped" along until the difficulty is overcome; so it should be in channel breaking, and this auxiliary could have easily been brought into use last winter if either of the ice boats' bows had been different.

If the "rooting" principle is carried out, of course the point or toe of the plough should be at the stem so far below the water line (and the boat should be trimmed by the stern,) as to pass under the ice, and the wings or mould boards should extend out a little beyond the line of the guards, (if side wheels are used:) on the deck there should be strong bulkheads placed at angles, the apex ahead; these shields should flare forwards and outwards, so as to prevent any ice from coming on deck, their angles acting in conjunction with the inclined surfaces of the "mould boards."

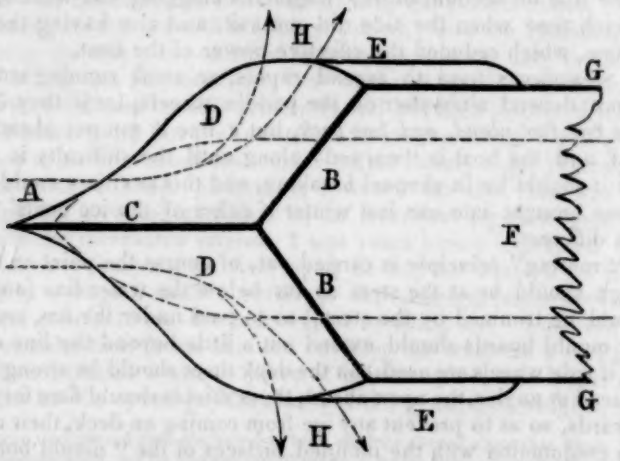
To facilitate the management of the boat, a central portion of the hurricane-deck could be extended to the bow clear of all below it.

Now, when this bow is run up against the solid ice, its first action would be to rip it up on the central ridge, and the mass on each side would be

forced up, the curved surfaces breaking into cakes, these passing off sidewise, and the impetus given would cause them to slide over the solid ice far enough from the channel to give no further trouble. On this principle the boat could work best with the tide, as the broken ice would be kept out of the way of the wheels or screw. But a better way to ensure a steady progress when the ice was thick and solid, would be to have a gang of men (pioneers), with a light sled, having on it a reel of "warping line," one end on the boat, the sled being run ahead, and the line payed out to its end, which is to be secured to hooks placed in holes cut in the ice; the boat is now to be forced ahead by the warp and the paddle wheels, which, as I before observed, should be attached to the engine by *friction couplings;* as the rope came in, it could be wound on another reel, so that when the hooks broke out, all could be hoisted out by a derrick, and placed on the bearings of the sled to be run ahead as before. When the ice was floating the propelling power would be sufficient; in fact, a properly constructed boat could run to and from salt water, fast enough to keep an open channel, (and this should be its only duty in winter, leaving towing to private enterprise,) as ice in a running stream does not form many inches thick in a day.

If this principle was carried out more fully in bridge piers, we should not hear of so many of them being carried away or injured every spring. I would advise skeptics, or those opposed to this principle, to visit Trenton Bridge at the breaking up of the ice, and there view its action, and they will see that the ice runs up the piers, breaks into fragments, falls and slides on the tops of the large masses passing unbroken between the piers, to be carried away on them.

As all are familiar with the form of a plough, the annexed diagram of a top view of the bow will make it intelligible.



A the stem; B B bulkheads; C the curved inclined cutting or breaking ridge; D D curved inclined surfaces corresponding to the "mould board" of a plough; E E bearers, solid with the boat's guards, but outside of them; their under surfaces formed like a "shoe" or broad runner, should be

about 18 inches above the water line, so that when "*rooting up*" thick ice, these bearers would slide on the surface of the solid ice or break its edge down; F the hull; G G the boat's guards; H H pointers, showing the direction of the fragments of ice as they slip off the inclines sidewise into the surface of the solid ice.

P. S. Since writing this communication, I have seen the model and a description in this *Journal*, of an ice boat, patented by H. & W. Brown. It does not materially differ from the plan I suggest, except in having side *guards*, and causing the broken ice to be passed *under* the solid ice on each side. I think that in practice these "*guards*" will be found to be an incumbrance, instead of a benefit, and also, that the same impulse given to a cake of ice will cause it slide *over* the surface to a distance many times greater, than the resistance of the water would allow it to go under the surface of the solid ice.

AMERICAN PATENTS.

List of American Patents which issued from December 9th, 1856, to January 6th, 1857, (inclusive,) with Exemplifications.

DECEMBER 9.

32. For an *Improved Machine for Feeding Paper to Printing Presses;* David Baldwin, Godwinville, New Jersey.

Claim.—"The method of feeding paper or other flexible material to printing presses, and other machines, which require the feed of a single sheet at a time, or separate feed of the sheets from a pile or number of sheets, by giving to or forming the sheet or sheets, with a lap or fold, or folds, and establishing the feed of said sheets, by means of a drawing or spreading out bar, or its equivalent, acting within or against the fold or folds of the sheets, to effect the separation and extension with certainty and despatch. Also, the employment of 'lap folded' paper, or other material, in sheets in such machine, when the fold or folds are made the means, by any suitable mechanical appliances, of effecting the ready separation and feed of the sheets. Also, when combined for operation together with an automatic feed of the lap folded sheets, a lap folding apparatus to fold the sheet after its delivery from the first feed or passage through the machine, for a second passage therethrough, by said feed acting against the fold or lap."

33. For an *Improvement in Sail-hanks;* Henry M. Bonney, New Bedford, Mass.

Claim.—"The arrangement of the hinge and the guard, relatively to the eye and the clasp, or connecting contrivance; the entire guard being in one piece, and fastened to the movable part of the body, and so as to be movable with it, and to open from and shut against the other part."

34. For an *Improved Alloy Composition;* Timothy Brown, Georgetown, N. Y.

Claim.—"The metallic composition or alloy, composed of zinc, from 56 to 70 parts; tin, from 18 to 8 parts; copper, 1 part; and antimony 1 part."

35. For an *Improvement in Valve Gear for Steam Engines;* Alfred S. Beebe, Fall River, Massachusetts.

Claim.—"The secondary toe, applied to the main toe, and operating in connexion with a sliding piece, or its equivalent, fitted to the lifter."

36. For an *Improved Yielding Joint for Portable Fences;* Robert J. Brown, Perry, Pennsylvania.

Claim.—"1st, The double dove-tail mortise and tenon joint of vertical posts, whether

of square or triangular scantling, and the rails, whether horizontal or inclined at an angle. 2d, Enlarging the circular or square picket holes of rails, on the side facing the picket."

37. For an *Improvement in Floats for Steam Boilers;* William S. Blake, Boston, Massachusetts.

Claim.—"The application of a steam gauge vapor generative float, with a closed steam boiler, and so as to have its contents vaporized by the heat of those in the boiler, in manner and for the purpose of resisting their pressure, exerted internally on the float, the boiler thus serving by the heat of its contents, to produce the agent by which the pressure of the steam on the external surface of the float is neutralized."

38. For an *Improved Machine for Pressing Hollow Brick or Building Blocks;* M. and J. H. Buck, and F. A. Cushman, Lebanon, New Hampshire.

Claim.—"Operating the plunger, by means of the peculiarly constructed cam, in combination with toggle and cross-pin—when the same are constructed and arranged to operate in relation to each other."

39. For an *Improvement in Elliptographs;* James W. Campbell, Brooklyn, N. Y.

Claim.—"Attaching the bar to the two beams of the plates, the pen being secured at the centre of said bar."

40. For an *Improved Gas Burner;* Job Cornell, Brooklyn, and Barnett McDougall, City of New York.

Claim.—"Increasing the width of the slit of the burner towards the centre, and bringing it to a sharp point, or nearly so, at the extremities."

41. For an *Improvement in Machines for Cutting the Stalks of Standing Corn;* Wm. B. Coates, Philadelphia, Pennsylvania.

Claim.—"The oblique knife, in combination with the connecting rod, universal joint, and crank, said rod being made adjustable for the purpose specified."

42. For an *Improved Arrangement of Valves, &c., in Siphon Rams;* Erastus W. Ellsworth, East Windsor Hill, Connecticut.

Claim.—"The combination of either or both the valves of the ram, with a governing key, whereby any or all of the same objects are accomplished, either in a siphon ram, or in a common hydraulic ram."

43. For a *Process for Mashing Grain;* Elie Joseph Hainaut, Kingdom of Belgium.

Claim.—"The process of mashing the grain or grains, either separately or combined, for the triple purpose of obtaining alcohol yeast, designed to be dried and pressed, and a mash sediment suitable for feeding cattle; the principal feature of which process consists in heating the said grain or grains in the macerator, by steam applied externally, instead of injecting the steam directly into the mass, as has been heretofore the practice."

44. For an *Improvement in Pocket Lamps;* Horace L. Hervey, Quincy, Illinois.

Claim.—"The combination of the revolving match holder, with the pawls, and spring catch, and the extinguisher, for the purpose of a portable pocket lamp."

45. For a *Portable Prairie Fence for Stock-pen;* Thomas Hoge, Waynesburgh, Pa.

Claim.—"The fence, or any other which will not collapse in being moved, arranged on a series of wheels, which are capable of being raised and lowered, and when lowered, locked."

46. For an *Improvement in Water Gauges for Steam Boilers;* F. A. Hoyt, Boston, Massachusetts.

Claim.—"The arrangement of the outside vessel, the dry steam chamber, and the float, having a direct communication with the indicating hand."

47. For an *Improvement in Teeth for Reaping Machines;* M. G. Hubbard, Penn Yan, New York.

Claim.—"Forming a tooth, by constructing the core thereof."

48. For an *Improvement in Potato Diggers;* William Mussehl, City of New York.

Claim.—"The revolving separator, in combination with the adjustable inclined shovel and mould boards."

49. For an *Improved Planing Machine;* Hudson Osgood, Waterville, Maine.

Claim.—"My improved arrangement of the endless bed and the belt of planes: that is, so that when a board is being planed by such, it shall be moved transversely under the planes, and the planes be drawn longitudinally over and against its surface."

50. For an *Improvement in Machines for Forging Iron;* Silas S. Putnam, Boston, Massachusetts.

Claim.—"The arrangement of the four hammers operating in pairs, and actuated by a single central cam."

51. For an *Improved Approach-opening Gate;* Wm. G. Phillips, Newport, Del.

Claim.—"Opening and closing a reciprocating gate or gates, by means of a falling weight, through the intervention of the cords, cranks, and rods."

52. For an *Improvement in Nut Machines;* Charles Ratcliff, Cincinnati, Ohio.

Claim.—"The two sets of dies, counter dies, and punches, arranged alternately upon the peripheries of a pair of rolls."

53. For a *Process of Preparing Tannate of Lime;* Obadiah Rich, Cambridge, Mass.; patented in England, Dec. 18, 1854.

Claim.—"The preparation of the tannate of lime, for manufacturing or commercial purposes."

54. For an *Improvement in Washing Machines;* Isaac S. Roland, West Earl, Penna.

Claim.—"The arrangement of the article to be washed, around the periphery of a revolving reel, in combination with the application of loose balls or blocks, both inside and outside thereof."

55. For an *Improvement in Corn Shellers;* Hamilton E. Smith, Philadelphia, Pa.

Claim.—"The combination of the cylinder and concave, when made and operated together."

56. For an *Improvement in Lathes for Irregular Forms;* Lemuel Smith, Plymouth, Connecticut.

Claim.—"The two expanding jaws, placed on the carriage, which works on the bed of the turning lathe, in combination with the pattern, the cutter being attached to one of the jaws."

57. For an *Improvement in Churns;* Charles A. Shaw, Biddeford, Maine.

Claim.—"Combining with the pendulous frame, and the mechanism connected therewith, for imparting to the dasher up and down motions, a mechanism, which at the same time will rotate the dasher on its axis, the dasher thus having at one and the same time, a compound movement, consisting of one in line of its axis, and one of rotation on its axis, whereby the operation of churning is greatly improved and facilitated."

58. For an *Improvement in Harvesters;* Wm. Tinker, Kelloggsville, Ohio.

Claim.—"The employment of the freely turning support, in combination with the bent lever, and scolloped wheel, for the purpose of securing said lever from strain, and at the same time of retaining the utmost facility and freedom of motion thereof."

59. For an *Improvement in Implements for Rolling Seeds in the Earth;* Anson Thompson, Glenn's Falls, New York.

Claim.—"The combination with the two series of separately revolving wheels, or narrow rollers, arranged (the several rollers and each series,) relatively to each other, of the frames constructed of slate, in connexion with the wheels."

60. For an *Improvement in Cleaning the Top Flats of Carding Engines;* Wm. H. Walton, City of New York.

Claim.—"Suspending the top flats, or lags, upon pivots in the centre of their ends, by which they can be raised out of the way of the adjoining flats or lags, to be turned by means of a rack, working in pinions upon their pivots, or the equivalent thereof. Also, stripping the flats, or workers, by a rotating brush, so arranged that a card may, in turn, strip the brush and return the strippings to the main cylinder."

61. For an *Improved Method of Cutting Curved Mouldings;* John J. Westerfield, New Brunswick, New Jersey.

Claim.—"The inclined bed, either of quadrant, circular, or elliptical form, and the conical head provided with curved cutters."

62. For an *Improvement in Seed Planters;* Henry Wyant, Knox County, Indiana.

Claim.—"The employment of the seed cup, or ring, and spring, attached to and moving with the slide, in combination with the inclined plane of the beam and brush."

63. For an *Improvement in Machines for Sticking Pins;* Charles Atwood, dec'd., late of the City of New York, per his Administrators.

Claim.—"1st, The twisted inclined conductors, as a means of changing the position of the pin. 2d, The falling railway. 3d, The separating, measuring, and spacing bolts, or instruments, terminating in a double inclined plane. 4th, The retarding spring, for holding the pins in check upon the rails, while being acted upon by the dividing instruments. 5th, The chuck for holding, guiding, and moving the paper. 6th, The elevator or plate for raising, holding, and delivering the paper. 7th, The connexion of the guiding grooves with the follower, or driver, in combination with the falling railway, and the retarding spring, and also of the guiding grooves and railway, in combination with the dividing, separating, and spacing instruments used, in combination with the inclined conducting channel."

64. For an *Improvement in Cigars;* Wm. P. Surgey, Hackney, Great Britain, Assignor to Charles H. Stanley, City of New York; patented in England, September 25, 1854.

Claim.—"Cigars, cheroots, and cigarettes, as a new and useful article of manufacture."

65. For an *Improvement in Machines for Husking Corn;* John Taggart and Leonard A. Grover, Roxbury, Assignors to selves and E. W. Banker, Boston, Mass.

Claim.—"The combination of the endless receiving and discharging carrier, the rotary cutter or saw, the inclined grated spout, and the toothed drum."

66. For an *Improvement in the Cylinder and Piston of Hydraulic and Steam Engines;* John Underwood, Lowell, Massachusetts.

Claim.—"The cylinder and piston."

67. For an *Improvement in Churns;* Wm. A. Vetrees, Winchester, Missouri.

Claim.—"The air tube, with its double acting valve."

68. For an *Improvement in Machines for Husking Corn;* Robert Bryson, Schenectady, New York.

Claim.—"The combination of the two endless aprons, corrugated rollers, and guard."

69. For an *Improved Machine for Stamping Leather, combined with a Rolling Machine;* Frederick Berry, Harrisburg, Pennsylvania.

Claim.—"The roller, which brings the stamp lever into action with the studs, when it falls off the leather on to the table, as the leather passes through the rolling machine."

70. For an *Improvement in Feed-water Pumps for Steam Boilers;* Erastus W. Ellsworth, East Windsor Hill, Connecticut.

Claim.—"The method of making a steam pump when applied to maintaining the level of water in steam boilers, or of other liquids in similar vessels, regulate its own speed by causing the liquid, when at or above the proper level, to apply resistance to the motion of the engine of the pump; that resistance being caused by the circulation of said liquid back and forth, through a narrow passage communicating between the above mentioned boiler or vessel, and a variable cavity operated by said engine—said variable cavity being constituted by a piston and plunger working in a cylinder, or in any similar manner, whereby substantially the same result is accomplished."

71. For a *Machine for Paging Books, &c.;* R. L. Hawes, Worcester, Massachusetts.

Claim.—"The general construction and arrangement of the machine, that is to say, pivoting the lever, which carries the numbering wheels to the frame work, and operating the wheels by means of the dog, the arm, and pin. Also, in combination with the

method of giving the impression by means of the revolving ribbon, I claim, giving to each type an independent bed or platen, and supporting the platen upon springs."

72. For an *Improved Mode of Incorporating Bituminous Liquids with Wet Earths for Cement;* Willis H. Johnson, Springfield, Illinois.

Claim.—"The combination of bituminous liquid and aqueous cements or mortars."

73. For an *Improvement in Seeding Machines;* James M. Kern, Morgantown, Va.

Claim.—"The combining with a seed box provided with a double set of passages, a hinged centre board, for the purpose of sowing both small or coarse grain, separately, or both at the same time, or grain and fertilizers."

74. For an *Improvement in Churns;* Goodrich Lightfoot, Elgin, Illinois.

Claim.—"The adjustable floats or buckets attached to the annular plate, which is secured to the shaft."

75 For *Candle Dipping Machines;* C. A. McPhetridge, St. Louis, Mo.

Claim.—"Dipping candles on a continuous wick, from spools, by pressing it through heated bees-wax in vat through gauge plate, and then alternatley through heated tallow and cold water, and through steam gauge box, and then separating them by means of the cutters. Also, the steam chambers or floats."

76. For an *Improvement in Seed Planters;* Edwin Moore, Avon, New York.

Claim.—"The hollow arms provided with flaps and beaks, or shares, at their ends—the arms being attached to a hub, provided with passages and cogs, and the perforated disk, and cut-off plate underneath the hopper."

77. For an *Improvement in Connecting Tubes;* Joseph Nason, City of New York.

Claim.—"The mode of joining the straight parallel tubes to the cross tubes, by means of screws and plain cylindrical joints upon the tubes, and screws upon both ends of the tubes—whereby the tubes are made to hold the cross tubes firmly in position, and the cylindrical ends of the tubes are left free to adjust themselves in their openings during the process of entering and screwing up the tubes, and afterwards when expanding unequally."

78. For an *Improvement in Making Cast Steel;* John Neville, City of New York, Assignor (through self and Lemuel Curtis, of New York aforesaid,) to the Damascus Steel Manufacturing Company, Croton, New York.

Claim.—"The process for converting wrought iron into cast steel, consisting essentially in the use of the various compounds of cyanogen and of sal-ammoniac, either separately or in combination with each other, or with other ingredients, when mixed and fused with the wrought iron which is to be thus converted."

79. For an *Improved Mode of Making Gutta Percha Cord;* James Reynolds, City of New York.

Claim.—"The process of finishing gutta percha cord by means of dies and grooved rollers, arranged and operating together, and on the cord—the said dies being of larger diameter than the grooves in the rollers, and serving to close up flaws, draw and compress the cord, and equalize its size, while the smaller grooves in the rollers serve to slightly compress and give a smooth finish to the cord, and establish or sustain the feed of the cord without risk of bruising by attrition, through a windlass action, and by which combined action of the dies and rollers, the cord is stretched to its 'fixed point' between the dies and rollers."

80. For an *Improvement in Prairie Ploughs;* Marshall Turley, Galesburg, Illinois.

Claim.—"The arrangement of the standard mould-board and side cutter, with regard to each other, and to the other parts of the plough, so that they will operate."

81. For an *Improved Trap for Catching Fish, &c.;* Levi Van Hoesen, Westville, Connecticut.

Claim.—"Forming the plates of the jaws and the stem or head piece, with portions of hollow spheres, for the purpose of protecting the bait when the jaws are sprung."

82. For an *Improvement in Ploughs;* George Watt, Richmond, Virginia.

Claim.—"The curved standard, when its front or concave side is rounded off, in

combination with the undulating lines, extending from the point of the plough to the tail of the mould board, and when formed by the intersection of the two curvilinear surfaces of the mould board and the standard."

83. For an *Improvement in Seeding Machines;* Moses D. Wells, Morgantown, Va.

Claim.—"The combination of the case with the swinging protruding agitators thereof, and the reciprocating bar contained within the case, and actuating the vibrating agitators."

84. For an *Improved Method of Charging the Receiver of a Locomotive with Compressed Air from Fixed Stations;* Samuel Carson, Assignor to the American Railway Manufacturing Company, City of New York.

Claim.—"The method of charging the receiver of a locomotive with compressed air, or other permanently elastic gas, from fixed stations, whilst the locomotive is in motion, and passing the station by means of the self-adapting apparatus."

85. For an *Improvement in Printing Presses;* Charles G. Sargent, Lowell, and Abram Keach, Boston, Assignors to Abram Keach and Caleb M. Marvel, Lowell, Mass.

Claim.—"1st, The method of operating the bed by means of the pins and the forked lever, when the motion of the latter is controlled by the spring lever. 2d, The wheels, constructed and operating in combination with the toes, whereby the nipper chain is fed simultaneously, and at the required moment receives a slight motion forward, for the purpose of opening one set, and closing another set of the nippers. 3d, The method of hanging and arranging the nipper chain and the platen upon the wheels and ways, whereby the platen may be moved out of the way, when it becomes necessary to change the form."

DECEMBER 16.

86. For an *Improvement in Adjustable Cant Hook for Moving Logs, &c.;* Mark Allcutt, Hancock, New Hampshire.

Claim.—"The arrangement and combination of the lever, with its pawl and slot, and the hook with its ratch notches."

87. For an *Improved Machine for Grinding Saws;* Emanuel Andrews, Elmira, N. Y.

Claim.—"1st, The manner for decreasing the transverse motion of the stone when I wish to grind the most, as at the outer edge of the saw, and increasing the same when I wish to grind less, as at the centre of the saw. 2d, The manner for the adjustment of the stone, for the purpose of using a portion of the grinding surface of the same at pleasure, or all the grinding surface if desired. I also claim, grinding saws to a taper, by means of the adjustable face plates, in combination with the pivot boxes, and sliding and yielding guides."

88. For an *Improved Case for Padlock;* Solomon Andrews, Perth Amboy, N. J.

Claim.—"The making of the body or case of a padlock, of one piece of wrought metal."

89. For an *Improved Method of Planing and Tapering Wooden Hoops;* Clark H. Brown, Forest Port, New York.

Claim.—"The combination of the saw and the adjustable or sliding planer, operated or adjusted by the movement of the carriage, through the medium of the lever, and the pendent, and arm, on the carriage."

90. For an *Improvement in Bake Pans;* Wm. Beach, Philadelphia, Penna.

Claim.—"The construction of metallic bake pans, with rounded corners, formed by notching, cutting, lapping, and riveting."

91. For an *Improvement in Valve Motions for Steam Engines;* John Butler, Dunmore, Pennsylvania.

Claim.—"The arrangement of the two rock shafts, with their rockers operating upon a yoke, or its equivalent, attached to the valve stem, and rock shafts deriving motion from separate eccentrics."

92. For an *Improved Spring Bolt;* Wm. E. Copeland, Fall River, Massachusetts.

Claim.—"My improved arrangement of the stop lever with respect to the bolt, and

so as to operate therein, and into and out of the bolt case. Also, combining with the main spiral spring, the secondary and separate spiral spring (or its equivalent), when the bolt is applied to its case, and the springs are arranged within a trapezoidal recess, or chamber of the bolt."

93. For an *Improvement in Pumps;* Jabez Coney, Boston, Massachusetts.

Claim.—"1st, Producing the reciprocating movement of the pump pistons, by the oblique disks, steel balls, and adjustable steel sockets. 2d, Constructing and arranging the duplicate cylinders, with their double acting pistons, in any odd number, five being the best, around the driving shaft, with its oblique disk, so as to be operated thereby from the centre. 3d, Enclosing the working parts in an oil cylinder, to keep them lubricated and free from dirt."

94. For an *Improvement in Railroad Car Coupling;* Charles Flanders, Charlestown, Massachusetts.

Claim.—"Combining and arranging the lifter and the spring, with the pin, the draw bar, and the elevating lever, so as to operate therewith."

95. For an *Improvement in Skate Runners;* John E. Forbes, Hoboken, N. J.

Claim.—"Forming the iron or runner of two parts or plates."

96. For an *Improved Filtering Faucet;* George H. Fox, Boston, and Henry J. Siller, East Cambridge, Massachusetts.

Claim.—"Causing a portion of the water, which has passed through the filter, to return in the opposite direction whenever the cock is closed, after using it for the purpose of cleansing the filter."

97. For an *Improvement in Lifting Jack;* Harvey Gray, Bristol, Connecticut.

Claim.—"The employment of the screw, yoke, roller, pawls, ratchets, in combination."

98. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"1st, Feeding up the thread to the needle by connecting the needle thread with the cloth feed motion, or by giving the needle thread an independent feed motion, so that there shall be sufficient thread, and no more, at each stitch fed in to the needle, to form the stitch—thereby causing the needle to draw the shuttle thread into the cloth, and never above it, for the purpose of ensuring the meeting of the loops or locks, within the body of the cloth. 2d, Fastening the cloth upon a slotted table moving with a rectilinear motion by means of a slotted curved spring—the slots in both spring and table corresponding with each other, and holding the cloth on both sides of the seam."

99. For an *Improved Portable Water Mill;* John Heller, East Lampeter, Penna.

Claim.—"The portable quadruple water power."

100. For an *Improved Portable Field Fence;* James G. Hunt, Reading, Ohio.

Claim.—"The compound triangular brace, in combination with the projection of one or more rails in whole part of one section or panel, beyond the slats or battens, and between the slats or battens of the adjoining panel."

101. For an *Improvement in Sewing Machines;* Lewis Jennings, City of N. York.

Claim.—"1st, The formation of the seam from a single thread, by passing each loop after it has passed through the cloth or material to be sewed, through its immediate successor, and round the second one which succeeds it, by means of a needle and a thumb, and a 'thumb and finger.' 2d, The combination of the arm, to which the thumb and finger are attached, the pivot, the slotted arm, the fixed pin, and the lever."

102. For an *Improvement in Ships' Windlass;* Peter H. Jackson, City of N. York.

Claim.—"The double-acting pawl, crank arm, and counter weight, applied to the heaver or heavers of the windlass."

103. For an *Improvement in Machinery for Grinding Paper Pulp;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The combination of the revolving grinding disk, having play in the direction of its axis, with the fixed grinding disks on either side of it, whereby the revolving disk is free to adjust itself, at such varying relative distances from the fixed disks as

may be required to prevent the grinder from clogging, and to adapt it to working properly upon different qualities of fibre, and under different rates of feeding. Also, the arrangement of the feeding and discharging orifices of the grinder and its grinding surfaces, so that the motion of the revolving disk will facilitate the entrance of the fibre into the grinder, tend to retard its discharge therefrom until properly reduced, and to keep it, while in at those places, where the grinding action is most energetic."

104. For an *Improvement in Machines for Paring Apples;* Horatio Keyes, Leominster, Massachusetts.

Claim.—"Giving the knife a circular movement entirely around the fork and apple thereon, by means of the wheel, with the arm and knife head attached, and the cam."

105. For an *Improved Boring Machine;* Samuel Klahr, Reamstown, Penna.

Claim.—"The arrangement and combination of the shaft, endless screw, pinion, and pulleys, as co-operating on an endless chain and railway carriage, for the purpose of boring pump stocks. Also, the shape and construction of the pinion and pulleys, with pins solid on one shaft. Also, the combination and arrangement of the drum, with the devices for operating both of the carriages for boring posts and pump stocks."

106. For an *Improvement in Photographic Baths;* William and William H. Lewis, City of New York.

Claim.—"Retaining the nitrate of silver bath in the desired inclined position, by the combined operation of the leg and button. Also, the solid glass pot, when formed with the curved sides and bottom, for the purpose of protecting the plate from injury, by contact with the bath or any sediment."

107. For an *Improvement in Railroad Gate for Cattle Guard;* Joseph T. McIntyre, Middletown, Delaware.

Claim.—"The arrangement of the tilting platforms, and the tilting cattle guards, with each other, and in connexion with the rails of railroads at the crossings of common roads, in such a manner, that the attempt to pass to the right or to the left from said crossings, on to the track or space between the enclosing fences, will, by the weight of the animals making the attempt, instantly raise a barrier before them, across the entire width of said railway space."

108. For an *Improvement in Harvesting Machines;* Robert J. Morrison, Richmond, Virginia.

Claim.—"Hinging the guard or shield by one of its ends to the frame, and supporting the other end thereof on the tongue, so that it may run or move on said tongue when the machine rises or falls, to accommodate itself to the inequalities of the ground, or for passing over water courses."

109. For an *Improved Press for Printing Hat Linings;* William Moultrie, City of New York.

Claim.—"The application and employment of the printing cylinder, or its equivalent, in combination with the feed and impression rollers, the fountain, the endless tapes, the drying vessel, and the revolving brush."

110. For *Improved Chimney Cowls;* Patrick Mihan, Boston, Mass.

Claim.—"My arrangement of hollow frustra with respect to each other, a smoke flue, and an inverted cone deflector, placed at and in the upper end of said smoke flue. Also, arranging on the flat top surface of the deflector, an enclosing deflecting guard, and a discharge spout, the same being disposed so as not only to gather the water which may fall on the top of the cone, and discharge it in one stream upon the inner surface of the upper external frustum, but so that the guard may serve to deflect a current of air which may strike on the top of the cone. Also, providing the cap plate, when it is directly over the conical deflector, with an opening, while the remainder of the cap plate may extend over the opening, between the cone and the outer cone—the same being to allow air to pass through the cap plate, and impinge on the top surface of the cone."

111. For an *Improved Mowing and Reaping Machine;* Jeremiah W. Mulley, Amsterdam, New York.

Claim.—"Connecting the frame of the platform with the frame carrying the driver's and raker's seat, in the manner, namely:—securing the relative position of the two frames, by means of the brace in the rear, and the laterally inclined draw-shoe in front.

Also, the rod and the rails connected, in combination with the pole, the rocking shaft, and the lever."

112. For an *Improvement in Machinery for Weaving Shade Cord;* Thomas Nelson, Troy, New York.

Claim.—"The arrangement of the inclined planes around a circle, and divided from each other by the chasm or pathway—the same being intended as the course or track of the spool cars. Also, the arrangement of the spool cars, in combination with the eccentrics which operate the cars in the rear of the inclined planes by means of pins, or equivalent apparatus, passing from the cars through slots in the planes. Also, the arrangement of carriers or shuttles, attached to the eccentrics, passing through the chasm between the upper and lower planes, and traversing circularly, and delivering the woof or filling between the threads of the warp, as they change their relative positions by the alternate elevations and depressions of the spool cars."

113. For an *Improvement in Grinding Mill;* Thomas B. Stout, Keyport, N. J.

Claim.—"The arrangement and combination of the feeding cavities, feeding apertures, and the form of dress given to the grinding surfaces."

114. For an *Improved Machine for Making Metallic Slats for Blinds;* John S. Samson and Wm. P. Farrand, Philadelphia, Pennsylvania.

Claim.—"The combination of bed, beam, and shear, with the spring stop."

115. For an *Improvement in Reaping and Mowing Machines;* Daniel C. Smith, Tecumseh, Michigan.

Claim.—"The combination of rock shaft, with hollow rock shaft, when the same are connected for joint operation in moving two sickles at once, by means of mechanism, arranged and operated in relation to each other from the main wheel."

116. For an *Improved Machine for Wiring Blind Rods;* Thaddeus F. St. John, Le Roy, New York.

Claim.—"1st, The device formed of the reciprocating bars, provided with the lever, having a hook at its lower end, the bars attached to the uprights—the lever being operated—by which device the staples are properly formed, and when formed, driven or forced into the rods or slots. 2d, The combination of the reciprocating bars and lever, arm, or lever, with the cutter attached, and the cam—the whole being arranged and operating conjointly."

117. For an *Improved Finger Bar for Harvesting Machines;* William H. Seymour, Brockport, New York.

Claim.—"1st, Casting the finger bar, composed of an upper and an under plate, united by the guard fingers, all in one piece. 2d, The openings in the back of the hollow finger bar, in combination with the inclined ribs. 3d. Ribs or partitions."

118. For an *Improved Mode of Securing Springs in Upholstery;* Wendell Wright, City of New York.

Claim.—"Securing the spring to its seats by having annular grooves made in the seats, one in each, and having the greater portion of the coils at the ends of the springs made or bent in horizontal form, and somewhat larger in diameter than the grooves, so that they will have a requisite bearing on the seats, and be retained by their elasticity within the grooves."

119. For an *Improvement in Apparatus for Coal Oil;* Richard Shroder, Darlington, Assignor to John S. Russell, Pittsburgh, and Richard Shroder and Alexander Anderson, Beaver County, Pennsylvania.

Claim.—"Constructing the retort or generator, with openings at different heights, for the purpose of obtaining oil of different qualities."

120. For an *Improved Machine for Cutting and Folding Paper;* Charles Moore, Hartford, Conn., Assignor to Wm. G. Sheldon, City of N. Y., and Lorenzo B. Chandler and Charles Moore, Hartford, Connecticut.

Claim.—"1st, The use of a frisket, with a blade or cutter attached thereto, in combination with a stationary cutter or blade, for the purpose of cutting a sheet of paper in two parts, by one and the same operation. 2d, The crimping blades. 3d, In combination with the crimping blades, the use of folders either with or without the auxiliary

frisket. 4th, The use of auxiliary friskets, when operated by projecting pins, or by any other competent mechanism, in conjunction with the folder, to carry over such parts of the sheet to be folded as will not, when operated upon by the folding blade, sustain and carry over their own weight. 5th, The combined contrivance of the take-off, and the crimping blade of the last fold, or the combination of the take-off with any other blade designed to co-operate therewith, for the purpose of clasping the folded sheet, or sheets, and of carrying them off, and of discharging them from the machine. 6th, The arrangement of the spring and pawl, or their equivalents, operating the take-off. 7th, The use of sliding or movable beds, with hanging sides, as a means of arranging the cutting, crimping, and folding mechanism, and all the cams, levers, springs, racks, &c., which operate the same, so that the machine may be expanded or contracted without disarranging the parts on which the proper motions depend. 8th, The punching points or pins, in connexion with the corresponding holes of the crimping blade."

121. For an *Improvement in Wind Mills;* Solomon W. Ruggles, Assignor to Silas Ruggles, Fitchburg, Massachusetts.

Claim.—"The disk and buckets, in combination with the wire or rod connected with the vane."

122. For an *Improvement in Reaping and Mowing Machines;* Thomas D. Burrall, Geneva, New York.

Claim.—"Placing the front edge of the cutter bar on the line, or nearly so, of the front edge of the finger board, when said finger board is formed with the raised front edge or lip, leaving free space below and behind the cutter bar, for any extraneous substances to escape from beneath said cutter bar, and pass freely away to the rear, with the grass or grain."

123. For an *Improved Apparatus for Drying Grain in the Mass;* John C. Pedrick, Washington, D. C.

Claim.—"The double convex lenticular vessel or perforated exhaust chamber, or its equivalent, for drying grain in bulk, in granaries or in vessels."

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124. For an *Improvement in Ploughs;* Jonathan Adams, Eatonton, Georgia.

Claim.—"The peculiar manner of holding the slotted mould-board, share, or hoe, to the stock, viz: by means of the curved brace, with its shank and shoulders extending from the beam, and against and through the hoe and stock."

125. For an *Improvement in Cider Mills;* Harry Abbott, Huron, New York.

Claim.—"The arrangement of the small pressing rollers in the arc of a circle, upon vibratory arms, to which the pressing power is applied."

126. For an *Improvement in Steam Boilers;* John Armstrong, New Orleans, La.

Claim.—"The series of cylinders placed vertically in rows, with a series of horizontal flues passing through each row, and lying in the vertical plane, cutting the centre of each cylinder—the space between each row of vertical cylinders being closed at the top by a horizontal flue boiler, all the vertical cylinders being connected together at the top and the bottom, and the furnace being located in one end of the space between the rows of vertical cylinders."

127. For an *Improvement in Printing Presses;* G. H. Babcock, Westerly, R. I.

Claim.—"1st, Attaching the bed and the platen together by means of the joint, when each is made to oscillate from a fixed centre. 2d, Giving an impression by means of the joint oscillation of the bed and platen. 3d, Operating the frisket by means of the weight, in combination with the motion of the platen."

128. For an *Improved Mode of Securing Braces in the Snath of a Grain Cradle;* Wm. W. Ryan, Schaghticoke, New York.

Claim.—"The application of a wedge-formed bolt or pin."

129. For an *Improved Portable Field Fence;* Wm. B. Burnett, Lyons, New York.

Claim.—"Constructing the panels of a portable fence with alternately abutting rails, in combination with the binding clamp."

130. For an *Improvement in Machinery for Folding Paper;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—"1st, The combination of the blades with the griping bars. 2d, The blades, in combination with the fingers. 3d, The cutting away a portion of the face of one of each pair of griping bars, and also of the edge of each of the blades, so that I may gripe the paper without binding the blades."

131. For an *Improvement in Rotary Egg Beaters;* Ralph Collier, Assignor to Alfred H. Reip and Ralph Collier, Baltimore, Maryland.

Claim.—"Vertically revolving stirring blades, made of metallic wire."

132. For an *Improvement in Stoves and Furnaces;* Theodore Cook, Springfield, Mass.

Claim.—"The fire chamber or pot, chamber, and cases, provided with the necessary pipes."

133. For an *Improvement in Machines for Cutting India Rubber Thread;* Henry Davenport, City of New York.

Claim.—"The combination of the cylinders or drums, over which the endless belt of india rubber from which the thread is to be cut is stretched, with the revolving circular cutters attached to the table."

134. For an *Improved Hand Printing Press;* Platt Evans, Jr., Cincinnati, Ohio.

Claim.—"So connecting the platen with the follower, that the upward motions of the follower shall remove the platen from the ink pad, and bring it back again, and during every alternate downward motion of the follower, the platen shall remain over the ink pad, and under the type follower. Also, the mode of communicating the motions of the follower to the platen—the same consisting of the double inclined guide, with its stops or checks, and the forked toggle, operated by a spring, and having bearings in the short arm of the lever."

135. For an *Improvement in Looms;* Andrew L. Fuller, Clinton, Massachusetts.

Claim.—"Regulating or changing the feed by governing the action of the lever, by means of the graduated stop, or its equivalent, in connexion with the change of a slide and pattern. 2d, The guard, for lifting the fingers. 3d, The flexible connexion between the stop and the rod, or slide, to allow motion to the stop, without moving the slide."

136. For an *Improved Spring Hinge;* John T. Garlick, City of New York.

Claim.—"A hinge, or series of hinges, attached to a double leafed spring."

137. For an *Improved Hoof Expander;* C. B. and S. Galentine and A. J. Russell, Nunda, New York.

Claim.—"The application of any instrument worked by a thumb screw, or other form of lever, so small as not to interfere with the operation of nailing the shoe to the hoof of the animal."

138. For an *Improvement in Mowing Machines;* Andrew M. Hall, West Falmouth, Maine.

Claim.—"Operating the pitman."

139. For an *Improvement in Trimming Card Clothing;* Edward B. Howe, Lowell, Massachusetts.

Claim.—"The arrangement of the adjustable guide and clamp, with its adjustable tool holder operated thereon, and the guide bar for guiding the card clothing by the card teeth set therein, and the points in this bar to hold the card clothing while it is being trimmed on both edges at the same time, and parallel with the card teeth therein."

140. For an *Improvement in Bedstead Fastenings;* Sandy Harris, Philadelphia, Pa.

Claim.—"The combination of the dove-tail with the staple, or mortised projection, termed the wedge box, and its key, acting upon an inclined face."

141. For an *Improvement in Ploughs;* Jacob Heckendorn, Elkton, Maryland.

Claim.—"The twisted, four coultered, double-ended, and reversible, self-sharpening point, formed of one piece or casting, and operating as point and coulter."

142. For an *Improvement in Paper Pulp Engine;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The method of regulating the feeding of the fibre to the grinder, by varying the hydraulic pressure by means of an adjustable discharging nozzle."

143. For an *Improvement in Hemp Brakes;* Edward W. Lacy, Oak Park, Va.

Claim.—"The adjustable weight to be used with, or governed by a treadle roller, to regulate at pleasure the momentum of the blow upon the stalks."

144. For an *Improved Machine for Pointing Shoe Pegs;* Jesse Ladd, Holderness, New Hampshire.

Claim.—"The employment of the fluted or toothed feed roller, in combination with the vibrating bed, composed of the fingers, &c."

145. For an *Improvement in Sewing Machines;* Wm. R. Landfear, Manchester, Conn.

Claim.—"1st, The manner of regulating the length of stitch, by raising and lowering the fulcrum—thereby changing the relative lengths of the two arms of the lever. 2d, The manner of combining the shuttle guide with the crank and fulcrum, for the purpose of giving the shuttle a downward motion when the stitch is tightened."

146. For an *Improved Door Fastener;* James Letort, Wytheville, Virginia.

Claim.—"The employment of the bent lever bolt, when in combination with the blade, or other additional blades."

147. For an *Improvement in Blacksmith's Crane;* Wm. Maher, Slack, Kentucky.

Claim.—"The horizontal bar hung upon the screw, and used in connexion with the windlass."

148. For an *Improved Device for Operating Fluid Metres by Hand;* Wm. Mason, Warren, Massachusetts.

Claim.—"The two concave flanched disks, and the flexible diaphragm, and provided with any suitable arrangement of passages, and with a faucet, or its equivalent, to change the passages to admit water to each side of the flexible diaphragm alternately."

149. For an *Improvement in the Manufacture of Hosiery;* William H. McNary, Brooklyn, New York.

Claim.—"The production of the heels and toes of hosiery, by knitting a spherical piece on the cylindrical or straight portions of the leg or foot, by the mode of operation whereby the same number of stitches is always left remaining on the needles, and the cylindrical or straight portion is enabled to be proceeded with again, when desired—thus enabling the whole leg and foot to be produced by a continuous operation of the devices or machinery employed."

150. For an *Improved Arrangement of Railroad Platform Scales;* Lea Pusey, Downingtown, Pennsylvania.

Claim.—"The arrangement of the platform of a railroad scale, either in the main or subsidiary track of a railroad, so that when the said platform is not in use for weighing as a railroad scale, the locomotive and train may pass directly over the same without bearing upon the said platform or scale; and also, so that the cars may be passed on and off the said scale in the course of weighing without crossing the track, and, therefore, without using a 'frog,' or its substitute—whereby all the advantages, heretofore derived from a 'siding' constructed for preserving the scale from the injurious effects of the locomotives and trains passing rapidly over it, are equally attained, and the room and expense required for the construction and use of the said 'siding' entirely avoided."

151. For an *Improvement in Hot Air Furnaces;* John H. H. Perkins, Utica, N. Y.

Claim.—"The mode of heating air for warming purposes, by passing it through the hot air chamber, in close sub-chambers and pipes; the main chamber being filled with air and steam commingled, and heated by the furnace or stove."

152. For an *Improvement in Breech Loading Fire Arms;* Hermann Schroeder, Louis Salewski and William Schmidt, Bloomington, Illinois.

Claim.—"The cocking of the hammer, in the act of moving the barrel forward to charge it, by a combination of mechanical parts."

153. For an *Improvement in Shirts;* Seligman H. and Joseph Strouse, City of N. Y.

Claim.—"The yoke constructed with curved springs, in combination with the manner of attaching the same to the back of the shirt, with the gathers in the centre."

154. For an *Improvement in Tinner's Shears;* Levi Skeels, Ostrander, Ohio.

Claim.—"1st, The rotary and sliding clamp, in combination with the straight shears, for the cutting of circular forms. 2d, The arrangement and combination of the hinged bench with the fixed bench or frame, and with the shears."

155. For an *Improvement in Corn Sheilers;* Edgar M. Stevens, Boston, Mass.

Claim.—"The self-acting cylinder, in combination with the presser bar and bed."

156. For an *Improvement in Trusspads;* Sylvester I. Sherman, City of New York.

Claim.—"Rendering the joint of truss-pads, rigid in any desired position, by compressing the ball between two plates."

157. For an *Improvement in Preparing Vegetable Fibres for Stuffing Mattresses and Cushions;* Werner Staufen, Prussia; patented in England, Nov. 12, 1855.

Claim.—"A new manufacture as an article for stuffing mattresses, cushions, &c., produced by permanently curling any suitable vegetable fibrous substance by this method."

158. For an *Improved Mode of Connecting Shafts with the Axle-Trees;* Alfred E. Smith, Bronxville, New York.

Claim.—"The manner of connecting the thills or shafts of a carriage with the axle-tree, by means of journals on the plate attached to each of the thills—one of the said journals being of greater diameter than the thickness of the plate from which it projects, and the said journals being fitted to holes in the ears, one of which ears is provided with a slot of less width than the diameter of the journal fitted to its hole, and large enough to allow the plate to slide in it freely."

159. For an *Improved Method of Hanging Reciprocating Gig Saws;* John Stowell, Charlestown, Massachusetts.

Claim.—"Attaching the saw to the two levers, when the axes of said levers are fitted in an oscillating frame, the journals of which are fitted in slots or grooves, or in a swinging frame, to allow a forward and backward movement of the frame."

160. For an *Improvement in Melodeons;* Gideon O. Spence, Elmira, New York.

Claim.—"The application of the third pedal to the receiver of melodeons, for facilitating the production of the crescendo and diminuendo."

161. For an *Improvement in Knitting Machines;* Clark Tompkins, Troy, N. Y.

Claim.—"The improvement of driving the rough roller of the take-up mechanism of a rotary knitting machine, by means of rotary friction plates, or their equivalents, instead of giving a positive rotary motion to this roller, as heretofore; so that this draft roller, with its incumbent take-up roller, without any additional mechanism, or any re-adjustment, continually gives the same tension to the web in knitting, however much the yarn varies in size, or whether much or little yarn is fed to the needles, or whatever quantity of web is on the take-up roller."

162. For an *Improvement in Lubricating Spindle Steps;* John Welsh, Philadelphia, Pennsylvania.

Claim.—"Making the groove or grooves, or their equivalents, at the lower end of the tube, so as to conduct thereby during the rotary motion of the said tube, the surplus oil from the spindle to the horizontal face of the step."

163. For an *Improved Fountain Pen;* A. F. Warren, Brooklyn, New York.

Claim.—"Attaching the pen holder to the sliding tube, by means of the rod, so that the pen may be drawn within and shoved out from the cylinder or ink reservoir. Also, constructing the pen holder of the two plates and plug."

164. For an *Improvement in Portable Head Rests;* Allen B. Wilson, Waterbury, Conn.

Claim.—"A head rest, composed of a pad, or other piece, to rest upon the back and shoulders, or either, supporting a pad of proper form, to receive the back of the head, or otherwise constructed, support the head without any attachment to the seat, or to any fixed object. Also, making the said head rest with its pads flexible, and its supports

consisting of a number of independent or unconnected ribs, so as to give the greatest ease to the wearer, and enable it to be rolled or folded up when not in use. Also, the sling combined with the head rest to receive the arm, for the two purposes of keeping the rest in place, and protecting the pockets."

165. For an *Improved Machine for Trimming Bolts;* Wm. Hannah, Assignor to L. H. Bowen and Wm. Hannah, Middlefield, New York.

Claim.—"The arrangement of the sliding and stationary dies, and operating with the sliding face plate, in connexion with the horizontal lever and eccentric."

166. For an *Improvement in Weighing Scales;* Elnathan Sampson, Assignor to the Vergennes Scale Manufacturing Co., Vergennes, Vermont.

Claim.—"The peculiar arrangement and operation of the respective parts of my improved compound weighing poise, viz: combining the outer portion of said poise with the main portion thereof, in such a manner that the act of rotating the outer portion of the poise, will move it longitudinally upon the main portion thereof, by a graduated movement, and at the same time indicate the different leverage action thereby produced upon the scale beam, by means of a toothed horizontal index on the main portion of the poise, and a spiral groove, and a numbered spiral scale on the periphery of the outer portion of the poise, whilst the entire poise can be moved longitudinally upon a rod situated immediately above the scale beam, and the leverage exerted by said poise, when its respective parts are compactly united, be indicated by a vertical index descending from the main portion of said poise, immediately in front of the numbered scale of the scale beam."

167. For an *Improvement in Converting Reciprocating into Rotary Motion;* Samuel Gissinger and John W. Kellberg, Allegheny City, Assignors to D. A. Morris, Pittsburgh, Pennsylvania.

Claim.—"The combination of the disk, having an externally notched rim, and being attached to the shaft to be rotated—the standard, or its equivalent, containing a double arc-formed slot—the bar that is connected by a vibrating rod with the piston rod, or other reciprocating object, the pin, the levers, and springs."

168. For an *Improvement in Burning Charcoal;* Andrew Grimes, Assignor to Charles Day, Lancaster, New York.

Claim.—"Burning wood in the open air, without any covering of earth, or any substitute therefor, in such a manner as to reduce any given amount of wood to a mass of red hot coals—preventing the pile from burning to ashes until the result is accomplished."

169. For an *Improvement in Machinery for Sizing Hat Bodies;* Sylvester H. Gray, Assignor to self and Francis Ives, Bridgeport, Connecticut.

Claim.—"Attaching the guide to the rear end of the vibrating carriage. Also, the use of the adjustable steam chest, in combination with the vibrating carriage, and the revolving endless bed or carriage."

170. For an *Improvement in Looms;* Benjamin G. Dawley, Assignor to Z. Allen, North Providence, Rhode Island.

Claim.—"The use of an intermediate wheel or wheels, to balance and regulate the tension in the delivery of the warp from two or more yarn beams combined together, to form one web of wide cloth."

171. For an *Improvement in Automatic Rakes for Harvesters;* Samuel Comfort, Morrisville, Penna., Assignor to Edward S. Renwick, City of New York.

Claim.—"1st, The combination of the rake handle, the guide, which its upper end traverses, and the lever to vibrate the rake in and out. 2d, The counter loading of the rake, for the purpose of rendering the draft of the machine more equable. 3d, The combination of the rake with the mechanism for moving the same to and fro over the platform, with a traversing carriage. 4th, The method of discharging the gavel before being bound, by dropping it from between the rake teeth and the plate, while the machine is in motion, as if it were standing still, by neutralizing the forward motion derived by the gavel from the machine by its backward motion derived from the rake. 5th, The combination of the rack and pinion, or the equivalent thereof, with the rake, whereby the motions are generated for traversing the rake—first along the platform to gather the grain into a gavel, and then across the platform to discharge the gavel."

172. For an *Improved Machine for Cutting Veneers from the Log;* Joseph H. Goodell, Bridgeport, Connecticut.

Claim.—"The combination and arrangement of the reciprocating log-carrying slide, unsupported by trunnions or axles for its curvilinear play, with the fixed guiding strips, and stationary knife, when said guiding strips serve as the sole guide to give to the log carrier its curvilinear movement and simultaneous side action; whereby a steadier and more reliable united double bearing is given to the log in its movements, the log may be secured with facility to the carrier, and the driving power is communicated to the log in a more positive and direct manner, for cutting with increased ease and precision thin veneers. Also, hinging the knife holding frame to the main knife feeding slide or frame, for the easy and double adjustability of the knife."

173. For an *Improved Method of Adjusting the Bits of Carpenter's Planes;* Thomas D. Worrall, Lowell, Massachusetts.

Claim.—"The arrangement of the rack and pinion, and the clamp, so that while the pinion is placed within the clamp, the rear or dove-tailed sides of the rack bar shall serve as bearings for the clamp to work against."

174. For an *Improvement in Spring Bed Bottoms;* Elkan Adler, City of N. York.

Claim.—"The combination of the metal caps, connecting links, or straps, and springs."

175 For an *Improved Machine for Feeding Paper to Printing Presses;* Moses S. Beach, Brooklyn, New York.

Claim—"Turning the sheet and delivering it to the impression cylinder for a second impression, by means of an extra or second cylinder, or its equivalent. Also, the arrangement and construction of the twin-fingers."

176. For an *Improvement in Horse Fastenings;* James Bolton, Richmond, Va.

Claim.—"The combination of a ratchet wheel with the hub of a wheel of a vehicle, and with a tie rein capable of adjustment, so as to bear equally on both sides of the bit of a horse, or other animal used for draft, whereby the rein is drawn, and the animal is checked if he move forward, and the rein is loosed if he move backward."

177. For an *Improvement in Harvesting Machines;* Joseph Carpenter, Yorktown, New York.

Claim.—"The employment or use of the two levers connected by the strap, and attached to the frame and bars, to which the wheels are attached."

178. For an *Improvement in Seed Planters;* N. C. Sherman and J. Mason, Hazle Green, Wisconsin.

Claim.—"The double plunger, having bars operating and combined with the seed box."

179. For an *Improvement in Sewing Machines;* A. F. Johnson and F. A. Houghton, Boston, Massachusetts.

Claim.—"The arrangement of parts of a spring power mechanism, when combined with a sewing machine, and located in a box, forming the pedestal of said machine. Also, the device by which the machine is made self-regulating, as to speed—consisting of the lever, brake, in combination with the fan-wheel attached to the loose collar."

180. For an *Improvement in Process of Grinding Paper Pulp;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The process of reducing fibrous matter in water, to pulp, by grinding it under hydraulic pressure, which creates a current that feeds the fibre into the grinder, and removes it therefrom as fast as it is sufficiently reduced, and renders the feeding independent of the grinding."

181. For an *Improvement in Smoke-Consuming Furnaces;* John Case and Isaac Soules, Amsterdam, New York.

Claim.—"1st, The arrangement of the fire and the smoke chambers, the direct and the return flues, the gas and the air pumps, the pipes to supply air above and below the grate, and the waste pipes for the spent gases. 2d, The combination with the smoke chamber and direct and return flues of the diaphragms, to direct the gases downward and backward as they enter the smoke chamber to facilitate the precipitation of the

sparks and thoroughly oxydated gases, from those gases which are but partially burnt, and require for the completion of their combustion to be returned to the fire chamber. 3d, The arrangement at or near the bottom of the smoke chamber of an open orifice, for the free and constant escape of the waste gases, in combination with the smoke chamber, and direct and return flues. 4th, In combination with the smoke chamber, arranging the hot gas and cold air pumps."

182. For an *Improvement in Hay Rakes;* John J. Squire, St. Louis, Missouri.

Claim.—"The clutch and levers operating the same, in combination with the arm of the rake shaft, and the connexion between said arm and lever, whereby the rake is lifted by the moving power, and automatically released."

183. For an *Improvement in Manufacturing Callender Rolls;* John Worsley, Providence, Rhode Island.

Claim.—"The use and employment of husks of maize (indian corn), for making rolls instead of cotton, wood, paper, or any other substance now in use."

184. For an *Improvement in Refrigerators;* Charles Winship, New Haven, Conn.

Claim.—"The method of causing the fresh, cold, moist air, to perform the combined double functions, first, of ventilating and refrigerating the interior of the provision chamber, and then of protecting the exterior of said chamber."

185. For an *Improvement in Sewing Machines;* Jerome B. Woodruff, Washington, District of Columbia.

Claim.—"1st, The construction of a feed bar, sliding in a dove-tail or slotted guide, and moved by a lever connected with the feed bar by a swivel joint, or its equivalent, so as always to move the feed bar in a plane with the material being sewed—the feed bar being moved back the distance required for the length of the stitch, while the needle is in the material, and when the needle is withdrawn, is moved forward, carrying the material therewith. 2d, The arrangement of a series of pins, through which the needle thread is laced, for the purpose of giving a uniformity of tension affecting its twist. 3d, A balanced needle bar for sewing machines, when constructed in the form of a segment of a circle, operating the shuttle driver by one end direct, and carrying the needle by the other end, when the whole of said bar forms the arc of a circle, of which the point of suspension is the centre. 4th, A slotted shuttle driver, the same being operated direct from the needle bar, and so arranged that the shuttle may pass through the loop of the needle thread in its proper time, gradually decreasing its speed, and stopping at or about the same time with the needle. 5th, Carrying the shuttle back and forth by a single pin."

186. For an *Improvement in Machines for Sowing Seed Broadcast;* E. K. Haynes, Hanover, Assignor to self and A. M. Mowe, Lebanon, New Hampshire.

Claim.—"The scattering wheel, armed with air-agitating wings, when located between obliquely arranged parallel directing boards."

187. For an *Improvement in Counting Machines;* James A. Bazin, Canton, Mass.

Claim.—"The arrangement of the numbering wheels, and the parts immediately connected therewith; that is to say, hanging the pawls to the central drum within the rings."

Additional Improvements.

1. For an *Improvement in Hubs for Carriages;* Joseph Smith, Delaware, Ohio; patented February 19, 1856; additional dated December 16, 1856.

Claim.—"The combination of the boxes, cylinders, band, with the rollers."

2. For an *Improvement in Breech Loading Fire Arms;* Abner N. Newton, Richmond, Indiana; patented June 27, 1854; additional dated June 17, 1854; 2d additional dated December 23, 1856.

Claim.—"1st, The combination of lever with the breech pin. 2d, One or more lips, in combination with the breech pin. 3d, Cocking the gun by the backward movement of the breech pin. 4th, Cocking the gun by the tension lever. 5th, Forcing the part, or its equivalent, between the main spring and barrel, for the purpose of imparting ten-

sion to the spring. 6th, Relaxing the main spring, by removing the part. 7th, Attaching the main spring to the barrel. 8th, The combination of the hammer with the barrel, by means of supports. 9th, Sliding the breech pin wholly within the barrel."

RE-ISSUES FOR DECEMBER, 1856.

1. For an *Improvement in Curry Combs;* Wm. Beach, Philadelphia, Penna.; patented March 13, 1849; re-issued Feb. 12, 1850; re-re-issued Dec. 9, 1856.

Claim.—"The combing the trough shaped bars, which have the comb teeth on their edges, with the folded strips of metal which form the transverse bars, and receive the wire through them, forming a square, open, or hollow back comb. Also, the shank constructed with the fastening hole, made by bending the wire which saves the welding or drilling, and combined with the comb, so as to act with transverse bars and guards to the ends of the combs."

2. For an *Improvement in Marble Sawing Machines;* Jose Toll, Locust Grove, Ohio; patented Sept. 9, 1856; re-issued Dec. 9, 1856.

Claim.—"The particular combination and arrangement of the fender bars, with the adjustable guide pieces."

3. For an *Improvement in Sewing Machines;* Allen B. Wilson, Waterbury, Conn.; patented November 12, 1850; re-issued January 22, 1856; re-re-issued December 9, 1856.

Claim.—"1st, The combination in a single machine of these three following elements, namely: a table or platform to support the material to be sewed, holding it for the action of the needle, and presenting it properly to the grasp of the feeding apparatus; a sewing mechanism proper, consisting of a needle and shuttle, or their equivalent, and a mechanical feed automatic, and causing the cloth to progress regularly, to which the cloth is not attached, and so grasping the cloth that it may be turned and twisted by the hand of an operator, such twisting not interfering with the regular progression of the cloth, and the whole being constructed and acting together and in combination with each other. 2d, Moving a shuttle so shaped and held by its race that jaws may embrace it, by means of two jaws, which are alternately in contact with the shuttle, making and breaking their contact without any aid from cams or springs, or the equivalent of such device. 3d, A double pointed shuttle, in combination with jaws for driving it, whereby the shuttle may be thrown alternately from opposite directions through loops, without practically disturbing the loop thread."

4. For an *Improved Magazine Repeating and Needle Gun;* Edward Lindner, City of New York; patented June 27, 1854; re-issued December 23, 1856.

Claim.—"1st, The application of the rack, situated between the gun barrel and the cartridge barrel, and the construction of the piston, in connexion with the said rack, for the purpose of passing the cartridge into the revolving breech piece. 2d, The spiral spring round the needle, together with the jointed arm at the upper end of the hammer, acting upon the needle in such a manner that after said jointed arm has pressed the needle sufficiently far into the cartridge to ignite the priming, said arm is forced upwards, allowing thereby the needle to spring suddenly back, and pass under the arm by the action of the spring, by which any heating of the needle is prevented. 3d, Revolving the breech by the pin, when the said pin is so constructed and arranged that it will rotate after the revolution of the breech piece, and turn over at the moment it shall have passed the spiral groove, and return to its former position inclined. 4th, The ramming hammer."

5. For an *Improved Magazine Repeating and Needle Gun;* Edward Lindner, City of New York; patented June 27, 1854; re-issued (on division,) Dec. 23, 1856.

Claim.—"The combination of the igniting needle with the revolving cylinder, or breech-piece, when constructed, arranged, and operated in such a manner that the needle can only be projected when the proper aperture is presented to it, and will always be withdrawn previous to the revolution of the cylinder."

6. For an *Improvement in Manufacturing Carpets;* John G. Macnair, Norwich, Conn.; patented August 7, 1852; re-issued December 23, 1856.

Claim.—"The fabric produced by the double wefts, one or both of which are parti-

colored, in combination with the two sets of warps—one to divide and ingrain the wefts, and the other to bind in the wefts."

7. For a *Multiform Moulding Plane;* Thomas D. Worrall, Assignee (through Mifflin Paul) of Thomas Worrall, Lowell, Mass.; patented August 29, 1854; re-issued December 23, 1856.

Claim.—"The combination of a separate moulding part or slide, with the handle supporting part or body of the plane, and applied thereto by means of plates and screws, or equivalent devices, for the purpose not only of enabling it to be removed from said handle part or body, but to allow another such a slide (provided with a plane iron or cutter), whatever may be its pattern, to be used in the application of, or in combination with, such handle part, or body, as circumstances may require."

8. For an *Improved Machine for Reaming and Tapping Gas Fittings;* Henry A. Chapin, Springfield, Massachusetts; patented July 1, 1856; re-issued December 23, 1856.

Claim.—"The combination of the tool-holder with its spindle, when the said tool-holder is armed with its complement of bits or tools, and is capable of being turned upon an axis at right angles to, and independent of, the axis of the spindle, so that either tool may be revolved in the axis of the spindle. Also, the rotary tool-holder as constructed and operating in combination with the revolving chuck or clamp, for holding the fitting."

Designs for December, 1856.

1. For *Printing Types;* George Bruce, Albany, New York; December 2, 1856.

Claim.—"I call this new type, double small pica copper-plate script, and I claim the design."

2. For *Cooking Stoves;* Samuel W. Gibbs, Albany, Assignor to A. H. McArthur & Co., Hudson, New York; December 9, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, forming together the ornamental design for the plates of an elevated oven cooking stove."

3. For *Cooking Stoves;* S. W. Gibbs, Albany, New York, Assignor to G. W. Ball & Co., Cincinnati, Ohio; December 23, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, forming the ornamental design for the plates of a cooking stove."

4. For *Cooking Stoves;* Garrettson Smith and Henry Brown, Philadelphia, Penna.; December 23, 1856.

Claim.—"The design, configuration, and arrangement in bas-relief on the several plates, constituting stove design 'Young American.'"

5. For *Parlor Grates;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental configuration and design for a parlor stove grate."

6. For *Cooking Stoves;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental configuration and design for cook stove plates."

7. For *Parlor Cooking Stove;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental design and configuration of parlor cook stove plates."

8. For *Metallic Bedsteads;* John B. Wickersham, City of New York; December 23, 1856.

Claim.—"The ornamental design of the post, leg, and head-board of the bedstead."

9. For *Floor Cloths;* Antoine Glominski, Assignor to Deborah, A. E., and Nathaniel B. Powers, Lansingburgh, New York; December 23, 1856.

Claim.—"The arrangement of ornamental figures, forming a design for floor oil cloths, or other fabrics."

JANUARY 6, 1857.

1. For an *Improvement in Door Springs;* John Broughton, Chicago, Illinois.

Claim.—"Combining a flat or other suitable spring, with the leaves of the auxiliary hinge, or other actuating devices, by means of a compound or double-action toggle."

2. For an *Improvement in Grinding Mill;* James Culbertson, Covington, Ky.

Claim.—"The combination of the long feeding channels in the grinding surface of the burr, with the discharging channels situated in position just preceding the feeding channels in the revolution of the burr."

3. For an *Improved Cross-cut Sawing Machine;* Wm. Cady, Eaton, Ohio.

Claim.—"The connecting rod, vibrating lever, bar, lever, provided and connected with the saw, cord, lever, catch, and brake."

4. For an *Improvement in Bullet Moulds;* Tristram Campbell and Henry B. Poorman, St. Louis, Missouri.

Claim.—"The mechanical arrangement of the 'trough knife,' with the lever, drawbar, and springs."

5. For an *Improvement in Bosom Studs;* J. Perley Derby, Boston, Massachusetts.

Claim.—"A stem, to which is attached a slide, constructed with a slot and spring in the same, which, on being inserted through the holes of the garment, which it is intended to secure (be it shirt bosom or other parts of the apparel), can be moved or pushed as far as required, and there secured by the force of the spring before named."

6. For an *Improved Fire Hook;* John G. Ernst, Harrisburgh, Penna.

Claim.—"The hook, constructed of the two parts, and attached to the beam, which is provided with rounds, and mounted upon wheels."

7. For an *Improved Method of Applying Filters to Supply-pipes;* James Fernald, Boston, Massachusetts.

Claim.—"The combination with the main water pipe of a house, of a filter, an auxiliary pipe, and a waste pipe—the pipes being provided with cocks."

8. For an *Improved Machine for Upsetting Tire;* Russell W. Gates, Homer, Mich.

Claim.—"The use of the right and left threaded screw shaft, operated in connexion with the blocks."

9. For an *Improved Mortising Machine;* Charles Green, Bethel, Ohio.

Claim.—"The combination of the frame, or bar, with its slot, the ⊤ shaped bars or pieces, with their slots, slotted frames, or beds, pivoted in the rear to the bars, and carrying the revolving chisel, arbors, or axles, slotted and double arms, or connecting rods, and slotted driving arm, all arranged for operation together for the easy adjustment and simultaneous production, when desired, of different sized mortises in the one stick, and at varying distances apart."

10. For an *Improvement in Velocimeters for Vessels;* Andrew B. Gray and Alexander H. Brown, Washington, D. C.

Claim.—"The use of the adjustable paddle wheel, which can be graduated to any number of revolutions by presenting more or less surface of paddle to the action of the water, in order, first, to fix it at its true point for registering correctly; and, second, should any wear take place in the machinery for registering, it can at once be adjusted by changing the angle of the paddle."

11. For an *Improved Rotary Shears;* Anson Hardy, Dorchester, Massachusetts.

Claim.—"Dispensing with the top beam, or support, as commonly used, and supporting the carriage on the lower beam, to which the straight knife is attached, by which means I avoid the expense of, and objection to, a top beam. Also, the use of the revolving circular knife, when operated by two or more gears, that can be regulated so as to give any amount of drawing cut that may be required."

12. For an *Improvement in the Manufacture of Animal Traps;* C. Jillson, Worcester, Massachusetts.

Claim.—"A new manufacture of animal traps."

13. For an *Improvement in Traveling Trunks;* Henry Loewenberg, City of N. York.

Claim.—"The combination of the folding portions with the grooves and tongues, and the fastenings to make an extensible trunk."

14 For an *Improvement in Forming Joints for Sheet Metal;* J. J. Laubach, Easton, Pennsylvania.

Claim.—"The roller attached to the pendent and swinging bar, which is connected or jointed to the arm."

15. For an *Improvement in Hats;* Evan Morris, Philadelphia, Pennsylvania.

Claim.—"Cutting or slotting the 'band' of a hat to make that part of it soft and yielding to the head—whilst at the same time it is made to retain the requisite stiffness and support to give it durability."

16. For an *Improved Method of Adjusting Circular Saws to any required Disk;* Josiah B. Pomroy, Chicago, Illinois.

Claim.—"Combining the concave cheeks, set screws, with a circular saw which has a slit (or slits) extending outwards a short distance from its inner periphery, at the same time that the said saw has an undivided outer periphery."

17. For an *Improvement in Folding Umbrellas;* L. K. Selden, Haddam, Conn.

Claim.—"The braces connected by pivots, and attached by pivots to the ribs, stretchers, and handle."

18. For an *Improved Weather Strap, for Doors, Windows, &c.;* James Smith, Cleveland, Ohio.

Claim.—"In combination with a weather strip hung to its springs, a jointed rod and set screw for operating it, when said rod is made to press down the strip at one point only; and this I claim, whether the strip be arranged in the door, or in or under a shield on the door, or both."

19. For an *Improved Raking Attachment for Reapers;* James H. Thompson, Newark, New Jersey.

Claim.—"The vibrating and intermittently rotating shaft, when fitted or placed in the bar, and provided with teeth, and operated by the wheel, hubs, pawls, cranks, and connecting rod."

20. For an *Improvement in Cross-ties and Chairs for Railroads as a New Manufacture;* Andrew Teal, Aurora, Illinois.

Claim.—"My improved adjustable double chair, for supporting the rails of railways, and at the same time securing said rails in any desired position—the said double chair being composed of ⊤ shaped metallic rails of suitable length, combined with duplicate pairs of transversely grooved clamping blocks."

21. For an *Improvement in Maintaining Power for Time-Pieces;* James Tuorlinge, City of New York.

Claim.—"The fixed screw or circular incline carrying the weight, combined with the rod, or their equivalents, for communicating the motion and power from the said revolving weight to the wheel. Also, the retaining spring on the weight, combined with the fork and fingers, or their equivalents, that will lift the weight up bodily, and allow said retaining power to act."

22. For an *Improvement in Riding Saddles;* Seth Ward, Princeton, Indiana.

Claim.—"The application of an india rubber spring to the back part of the cantle, secured above and also below the semicircular opening of the cantle, by screw-plates, let in for the purpose of obviating the necessity for any springs, either under the seat or cantle, it in itself giving sufficient elasticity to the seat."

23. For an *Improved Self-regulating Wind Director for Wind-Mills;* Henry S. Wentworth, Napoleon, Michigan.

Claim.—"A semicircular revolving balance screen, operated variably by the power of the wind upon the revolving extra fan, for the purpose of admitting only the requisite current of air to the wheel, whether placed in a horizontal or vertical form."

24. For an *Improvement in Buckles;* George P. Woodruff, Watertown, Conn.

Claim.—"Constructing and combining together the bow and the tongue of a buckle in such manner that the strap is secured between the two, at the hinge of the buckle."

25. For an *Improvement in Air Heating Furnaces;* Joseph D. Greene and Edward Ivers, Assignors to Joseph D. Greene, Philadelphia, Penna.

Claim.—"The peculiar arrangement of the double series of smoke conducting and air heating tubes, with the other parts of our air heating apparatus, viz: the series of smoke conducting tubes being arranged around the exterior surface of the furnace chamber with their induction smallest ends uppermost, and the series of air heating tubes being arranged around the interior surface of the furnace chamber, with their induction smallest ends opening downwards, and both ends open to the atmosphere."

26. For an *Improvement in Ships' Cooking Stoves;* Daniel S. Beardsley, Assignor to self and John D. Umberfield, New Haven, Connecticut.

Claim.—"Hanging a stove to be used on ship board, by means of the hollow pivots and flue, so that the stove shall always maintain an upright position, and the draft not be interrupted."

27. For an *Improvement in Extension Tables;* Benjamin Clark, Assignor to E. L. Ferguson and C. B. Clark, Oriskany Falls, New York.

Claim.—"The combination of the fixed side pieces, with the table leaves and table legs—the side pieces serving the double purpose of holding the table firmly together, when compacted and closed, and also serving in conjunction with pieces to give stability to the frame, when the same is opened or extended."

28. For an *Improvement in Valves for Steam Engines;* Cornall Bradley, Manchester, Virginia.

Claim.—"The making the valves of steam engines with two surfaces—one being exposed to the action of the steam downwards against the valve seat—the other surface exerting a contrary pressure into the chamber—the inside of said chamber being in communication with the atmosphere."

29 For an *Improvement in Rudders;* A. B. Crossman, Huntington, New York.

Claim.—"The attachment to the rudder, of an extension piece, when the said extension piece is so combined and employed as to render the rudder wholly or partially self-balancing."

30 For an *Improvement in Carriages;* John W. Crannell, Olivet, Michigan.

Claim.—"The mode of constructing the carriage body in two parts, the inner ends chamfered or rounded below said bodies, being attached to two elastic bars, in combination with the independent seat frame, and carrying inside two springs, or their equivalents, in either a horizontal or vertical position, but whose action is horizontal and against the chamfered and detached ends of the carriage bodies, for the purpose of producing a gentle and undulating horizontal movement in the seat. Also, the use of the stop plates, operated by screws, or otherwise, for the purpose of regulating the elasticity of the springs."

31 For an *Improvement in Looms;* François Durand, Paris, France.

Claim.—"1st, The combination with a stationary race way, of a reed, passing entirely through the same. 2d, The weft thread needles, controlled by a jacquard machine, or other pattern mechanism, to operate upon the weft threads, in combination with a thread carrier. 3d, The unhooker, operating in combination with the thread carrier."

32. For an *Improvement in Tanning Hides;* Edwin Daniels, Lafayette, Wisconsin.

Claim.—"The use of saltpetre, alum, and sulphuric acid, respectively, in solution of catechu, or other substance containing an equivalent amount of tannin."

33. For an *Improvement in Anchors;* Thomas L. Dalton, City of New York.

Claim.—"An anchor."

34. For an *Improved Mode of Constructing Stalls for Horses;* Henry Eddy, North Bridgewater, Massachusetts.

Claim.—"A crib or manger, with the inclined planes. Also, the space partially inclosed by the inclined planes, with a vertical opening."

35. For an *Improvement in Operating Slide Valves for Steam Engines;* Robert H. Fletcher, Brooklyn, New York.

Claim.—"The arrangement of the slide valve and stem, with their operative parts within the steam chest, so that they may be operated from the piston head within the steam cylinder."

36. For an *Improvement in Instruments for Measuring Boards;* James Jones, Rochester, New York.

Claim.—"My means of so adapting the instrument, that it may be applied to the actual surface—whether of a board or other article—such means consisting of the outer and inner disks, combined with the two indices, one of said indices being intended to regulate the position of the friction roller on the inner disk, and the other for indicating the quantity measured."

37. For an *Improvement in Artificial Legs;* Benjamin W. Jewett, Gilford, N. H.

Claim.—"1st, The spiral spring, in combination with the rod, hook, and cross brace. 2d, The method of attaching the tendo-achilles and the cord to the thigh, by the use of the pins. 3d, The bolts, in combination with the straps and their metallic boxes."

38. For an *Improvement in Milking Shields;* Orwell H. Needham, City of N. York.

Claim.—"Combining the perforated band or ring, or its equivalent, with the yielding lining whereby an inward pressure against the teat, or nipple, is produced—the point of said pressure being changeable at pleasure."

39. For an *Improvement in Processes for Reducing Zinc Ores;* Samuel Wetherill, Bethlehem, Pennsylvania.

Claim.—"Causing the metallic vapors of zinc, driven off from the ore by heat, to pass through a charge of heated or incandescent coal, or other carbonaceous matter."

40. For an *Improvement in Making Cop Tubes;* Nathaniel Whitmore, Assignor to self, Somerville, and G. W. Keene, Lynn, Massachusetts.

Claim.—"The tube with its backing, in combination with the spindle. Also, the tubular step for the support of the tube while it is being flanched, in combination with the receiver."

41. For an *Improvement in Cultivator Teeth;* James P. Cramer, Assignor to Hiram Cramer, Schuylerville, New York.

Claim.—"My improved tooth, composed of a properly shaped sheet metal blade and shank, with an iron head cast upon the shank, and embracing its outer and inner surfaces in such a manner that the said blade, shank, and head of the tooth will form but a single piece."

42. For an *Improvement in Hemp Brakes;* Samuel H. Little, St. Louis, Missouri.

Claim.—"Placing the feeding rollers and the throat bars in one and the same movable frame, for the purpose of enabling said frame to be so adjusted as to give any desired space between said throat bars and the beating bars of the reciprocating gate, without varying the distance between said feeding rollers and the throat bars. Also, securing the throat bars within their supporting frame, in such a manner that they can be so adjusted as to form a wider or a narrower opening to the reception of hemp stalks of different sizes; but this I only claim, when the said throat bar supporting frame is so arranged in relation to the supporting frame of the reciprocating gate, that their distance from each other can be so adjusted that the action of the beaters will be exactly adapted to the size, quantity, and condition of the hemp stalks fed through said throat. Also, the combination of the shaking shoe with the reciprocating gate."

43. For an *Improvement in Pumps;* G. W. B. Gedney, City of New York.

Claim.—"The working leaf valve, or four-way cock, arranged with respect to the two cylinders and solid pistons, so as to give a more direct and unobstructed course to the water, than is obtained in the slide valve pump, patented by Webster."

MECHANICS, PHYSICS, AND CHEMISTRY.

*Notes on the Progress of Engineering, &c.**

Southampton, November 24th, 1856.

The United States steam frigate *Merrimac* sailed from here on the 29th ult., having had her defective foot-valves in air pumps replaced by new ones, with larger area through the gratings, the old valve-seats having 176 sq. in., and the new ones 230 sq. in. for each foot-valve, as mentioned in our last number.

We have been favored by Mr. Long, the chief engineer, with the result obtained by this increase, viz: in one engine 2 in., and in the other 1½ ins. more vacuum in the condensers.

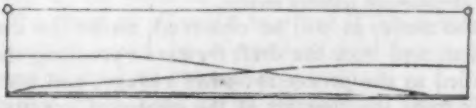
By a friction diagram taken from these engines, with the screw disconnected (that is, *hoisted*), and the vessel at anchor, the H. P. absorbed in friction alone appears to equal 71 H. P.; but of course this amount would be greater when the whole pressure of steam is admitted to the engines for propelling the vessel: in other words, the friction of the machinery, when *loaded*, would of course exceed the friction when the diagrams were taken. The actual amount of the increased friction of the load cannot, of course, be measured by the indicator, and must be a constantly varying quantity; but Mr. McNaught estimates it at $\frac{1}{20}$ th of the increased pressure upon the piston. The diagrams below are accurate copies of those obtained from the *Merrimac* under the beforementioned circumstances. It will be observed that the revolutions, at

MERRIMAC, "C." H. P. = 70·7

Friction Diagram, Forward Engine, October 23, 1856.
Revolutions, 40. Average Pressure, 2·39.

MERRIMAC, H. P. = 72·7.

Friction Diagram, After Engine, October 23, 1856.
Revolutions, 40. Average Pressure, 2·46.



the time the diagrams were taken, were only 40 per min., whereas the average revolutions at sea are about 45 per min.; but we think that the chief engineer exercised commendable caution in not allowing his engines to run too quick, as it is a delicate operation to try experiments on large engines when unloaded. We remember one instance in which the cylinder of a large paddle engine was split whilst running without the floats.

* From the Lond. Artizan, Dec., 1856.

The Peninsular and Oriental Company's screw steam ship *Simla* sailed, with the mails on board, on the 12th inst. for Sydney. She has been chartered for two years, by the European and Australian Royal Mail Company, and will run in conjunction with the *Oneida* and *European* from Sydney to Suez. The *Simla* is a very fine vessel, and has performed admirably during her long engagement in the transport service: one of her runs, viz., from Plymouth to Malta Harbour, in 6 days 20 hours, a distance of 2012 knots, has never been surpassed. She was built in Hull, and machinery by Messrs. Tod & McGregor of Glasgow, in 1854; has geared engines, the multiple being 110 to 37.

Diameter of cylinder,	90 ins.
Stroke of pistons,	6 ft. 6 "

Each piston has four rods, with the ordinary steeple motion. Screw propeller has three blades; diameter, 17 ft. 6 ins.; pitch, 23 ft., and uniform.

The boilers, four in number, are on Messrs. Lamb & Sumner's patent flue principle, and have produced very economical results, the consumption of coal at sea, being only 3·8 lbs. per indicated H. P. per hour.

The *Simla* was tried at the measured mile in Stoke's Bay on the 7th inst., a great number of scientific and commercial gentlemen interested in steam navigation being present. She was very deeply laden, having on board all her coal, stores, &c., for the voyage to Australia.

Her draft forward was	21·6	20 ft. 10½ ins. mean draft.
" aft	" 20·3	
	Tons.	
Coal on board	1460	Total dead weight on board = 1860 tons.
Water "	60	
Spare gear, &c.	40	
Stores and Cargo	300	

Immersed midship section, ... 648 sq. ft.

Log on Measured Mile.

Mile.	Time. M. Sec.	Speed.	Revs.	Steam. lbs.	Vacuum. ins.
1st, ...	4·42	12·776	19½	15½	26
2d, ...	5·25	11·077	19	15	26

Mean Speed	= 11·921 knots per hour.
Speed of Screw . . .	13· " "
Slip of "	1·1 "
Do. per cent . .	= 9.
Coefficient of immersed midship section, . .	623 sq. ft.

This trial was made, as will be observed, under the disadvantages of great immersion, and from the draft forward exceeding that aft; but this will be remedied as she proceeds on her voyage, and her coals are consumed, chiefly from the forepart of the centre of gravity of the vessel, which will lighten her more quickly forward than aft. She was tried June 28, 1854, on her arrival from Scotland, at the same measured mile, her draft being 18 ft. forward, and 17 ft. aft; immersed midship section =517 sq. ft., when her mean speed was 13·35 knots per hour.

The *Oneida*, which sailed from here on the 19th ult. for Sydney, arrived at St. Vincents on the 28th, after a fine run of nine days six hours; the distance is 2350 knots.

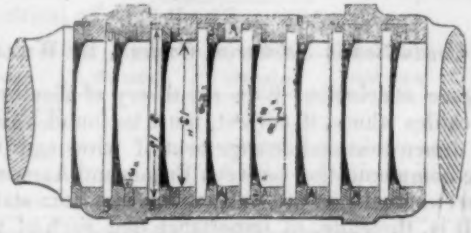
H. M. S. *Himalaya* is still at Plymouth, uncommissioned. We under-

stand that the Government engineers are so satisfied with the plan adopted by Gray, her late engineer, for the repair of her thrusting-block, that they have had the length of shafting which contains the thrusting-collars put into a lathe in the steam factory, and thoroughly carried out his plan, by turning the collars down to a true surface, and pinning brass rings, in halves, on to their thrusting surfaces. By this means the new brass rings will thrust against the lignum vitæ segments, whereas, before this alteration, the roughened iron collars formed the rubbing surface in contact with them. We mentioned in a former number that the idea of fitting these lignum vitæ segments occurred to Mr. Gray, in consequence of the rapid wear of the brass rings in the *Himalaya's* thrust-block; and we are pleased to be able to add that this simple method of quickly and cheaply renewing the thrusting surfaces of these blocks, is likely to be adopted in other government steamers, where the same difficulties have occurred. Mr. Gray has received the thanks of the commander of the *Himalaya*, Captain Priest, and also the expression of satisfaction from the Admiralty. We should like to hear of some more solid proof of their Lordship's appreciation of Mr. Gray's services.

Plan of Thrust-collars and Bearing, *Himalaya.*

Scale, 1½ in. = 1 ft.

A, A, A, are the lignum vitæ segments; B, B, the new brass rings.



By the subjoined sketch our readers will perceive that the thrusting surface in the *Himalaya's* thrust-block, has been increased from 496 sq. ins., as before the alteration, to 571 sq. ins. We may add that it is a very important item to the success of wood bearings that their surfaces shall be thoroughly lubricated; in the present case this is effected by scoring the surface of the brass rings with *races*, which allows the water to circulate freely on all parts of the collars. We believe that water must be allowed to flow on all wood bearings of this nature, as the small quantity of oil which could be allowed for lubrication, would not be sufficient to carry off the heat caused by friction.

The Belgian and New York screw steamship, *Leopold II.*, has just arrived here for the purpose of being docked for survey by Lloyd's Agents. She was built and fitted with machinery by the Cockerill Company, of Belgium, and is reputed to be a fast ship. She is about 1800 tons burden, with inverted cylinder engines of 340 nominal H. P.

Diameter of cylinders,	60 ins.
Stroke of piston,	4 ft.
Revolutions per minute, average,	35.
Nominal H. P. at above revolutions,	336.

Her engines have each two piston rods, the air pumps being worked by beams from the cylinder cross-heads, and so assisting to balance the weight of piston and connecting-rods.

There is also a large balance wheel keyed on to the crank shaft, which answers for turning engines by hand, and in some degree as a fly-wheel.

The screw is three-bladed, and projects beyond the after stern-post, as in Beattie's patent, the rudder being enclosed in the space between the two stern-posts, and the screw shaft dividing it in two pieces, which are connected by an oval looped rudder post. The screw is 18 feet diameter, and 36 feet pitch, so that with 35 revolutions of engines, the speed of screw equals 12·4 knots per hour; and, as the diameter is so very large (for the power transmitted through it) there is, of course, but little slip.

The tubular boilers have twelve furnaces, 3·8 wide, and 7 ft. long; thus giving 308 sq. ft. of grate surface; the tubes, 290 in number, are 7 ft. long, and 3¼ outside diameter. We hope to give some particulars of this vessel in our next.

The *Belgique*, belonging to the same Company, which sailed from here for New York last month, arrived at that port after a run of nineteen days, having met with very strong head winds the whole way across.

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*On Electrical Conduction in Submarine Cables.** By William Thomson.

There are some conclusions from my theory of electrical conduction in submarine cables which, if correct, must be found valuable in planning the best dimensions and arrangement of wires and insulating tubes for telegraphic communication between Britain and America:—an undertaking at present actually in progress, as appears from statements in the *Athenæum*. It is, therefore, of importance that such of your readers as may be interested in the subject should, without delay, have some evidence to allow them to judge as to the validity of the objections to those conclusions which Mr. Wildman Whitehouse made in his communication to the British Association at Cheltenham (reported *Athen.* August 30,) and which he still maintains in his letter recently addressed to you (*Athen.* Oct. 11,) notwithstanding my confident assertion of their correctness and my reference to the theoretical demonstration (*Proceedings of the Royal Society*, May 10, 1855, and *Philosophical Magazine*, vol. Jan. to June, 1856,) as supporting this assertion by unassailable evidence (*Athen.* Oct. 4). On this account, rather than from any desire to continue in your columns a controversy which I believe will be easily adjusted by private correspondence, I offer you the following remarks.

The points of greatest practical importance in my conclusions are, 1, "the law of squares," as it has been called by Mr. W. Whitehouse; and, 2, the influence of lateral dimensions of wire and insulating coat on the rapidity of signals by a submarine cable of stated length. It is on these points chiefly that Mr. W. Whitehouse brings his attack, and it is to these that I shall confine my present defence.

* From the Lond. Athenæum, November, 1856.

1. *Law of Squares.*—In his Cheltenham communication, Mr. W. Whitehouse brings forward the following table of results, as conclusive against the law of squares:—

Amount of Retardation observed at various Distances. Voltaic Current. Time stated in Parts of a Second.

Mean of 550 obsrvns.	Mean of 110 obsrvns.	Mean of 1840 obsrvns.	Mean of 1960 obsrvns.	Mean of 120 simultaneous observations.	
83 miles.	166 miles.	249 miles.	498 miles.	535 miles.	1020 miles.
·08	·14	·36	·79	·74	1·42

The retardation here shown as the results of undoubtedly trustworthy observations, are not proportional to the squares of the distances; but it depends on the nature of the electric operation performed at one extremity of the wire, and on the nature of the test afforded by the indicating instrument at the other extremity, whether or not any *approach to the law of squares is to be expected* in the observed results. Thus, the following table, which I have derived solely from theory,* shows for different lengths of cable, of certain lateral dimensions, the delays, from the instants of beginning various definitely specified electrical operations at one extremity experienced in waiting for the indications by each of two definite tests of electrical effect at the other extremity:—

Durations of battery action.	150 miles.		300 miles.		600 miles.		1200 miles.		2400 miles.	
	Times from beginning of battery-action till strength of current rises to									
	¾ max.	max.	¾ max.	max.	¾ max.	max	¾ max.	max.	¾ max.	max.
seconds	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.
·0	·011	·0164	·044	·0656	·175	·2622	·7	1·049	2·8	4·196
·333	·0378	·333	·145	·354	·353	·49	·84	1·17	2·93	4·27
·667	·0378	·667	·151	·667	·495	·78	1·08	1·45	3·07	4·4
1·000	·0378	1·000	·151	1·000	·504	1·104	1·25	1·70	3·20	4·53
8·	·0378	8·000	·151	8·000	·604	8·000	2·416	8·33	6·93	10·
16·	·0378	16·000	·151	16·000	·604	16·000	2·416	16·00	9·00	17·47
24·	·0378	24·000	·151	24·000	·604	24·000	2·416	24·00	9·00	25·33
∞	·0378	∞	·151	∞	·604	∞	2·416	∞	9·664	∞

The electrical operation to which the first horizontal series of numbers in the table refers is in strictness an infinitely short application of an infinitely intense electro-motive force; but, practically this condition will be realized to a sufficient degree of approximation for verifying the result by applying a powerful battery or an electro-magnetic impulse during one-twentieth, or any smaller fraction of the time, shown as the delay of the maximum in each case,—for instance, during $\frac{1}{120}$ of a second, or any less time, for the 150-mile cable, or during $\frac{1}{8}$th of a second or any less

* I have obtained the tabulated results merely by inspection from a diagram of curves published with my first communication to the Royal Society on the subject. The decimals will, no doubt, require some correction when exact calculations are made, as will very soon be the case. The lateral dimensions for which the table has been calculated are those of a single wire cable, copper wire ·065 in. diameter, gutta purcha tube ¼-in. outer diameter.

time for the cable of 2400 miles. The electrical operations referred to in the other horizontal lines consist of applications of one pole of a constant battery during the stated times. In every case the extremity operated on is supposed to be put in connexion with the earth at the instant when it is disconnected from the battery. The other extremity is supposed to be always kept in connexion with the earth. The conductor of the indicating instrument through which this connexion is established is supposed to exercise but a small resistance compared with that of any number of miles of the wire, and is assumed to give rise, by electro-magnetic induction, to no delay comparable with that due to the induction of the other kind (peristaltic induction) in the cable in each case. This last condition will be far from being fulfilled, except for the longest cable, when large coils with soft iron cores are used in the indicating instrument, as any one will be ready to admit who has seen Faraday's beautiful magneto-optical experiment, and has remarked the gradually rising illumination consequent on the sudden completion of the voltaic circuit.

Now, it will be observed that the law of squares is fulfilled throughout no horizontal line of the table, except the first and the last. If, for instance, we take the series of retardations of $\frac{3}{4}$ of maximum strength, and of maximum strength consequent on an application of the battery for one-third of a second, we have the following comparative view:—

Lengths, . .	150	300	600	1200	2400
Retardation of $\frac{3}{4}$ maximum, .	·0378	·145	·352	·84	2·93
Retardations of maximum, . .	·333	·354	·49	1·17	4·27

Here the retardation of the $\frac{3}{4}$ maximum is a little short of four times as much in the 300 mile cable as in the 150; it is only $2\frac{1}{2}$ times as much in the 600 as in the 300; only $2\frac{1}{2}$ times as much in the 1200 as in the 600; and only $3\frac{1}{2}$ times as much in the 2400 as in the 1200; instead of being 4 times greater in each of the longer cables than in the other of half-length, as it would be if the law of squares were applicable.

By comparing, on the same principle, Mr. W. Whitehouse's results quoted above (*Athen.* Aug. 30, p. 1093), we find very analogous *deviations from the law of squares;* but for a strict verification of their *agreement with theory*, it would be necessary to have a precise specification of the electrical operations which were performed at one extremity, and of the exact nature of the test of electrical effect afforded by the receiving instrument at the other extremity. The manuscript of the Cheltenham paper, to which, through the courtesy of Mr. Whitehouse, I have had access, shows that the operations were *certainly not such as could give effects on the whole manifesting the law of squares even approximately*, and makes me think it probable that electro-magnetic induction in the receiving instrument has most sensibly influenced the retardations observed with the shorter lengths of cable, increasing, relatively, those observed with the shortest. Each application of the battery appears to have been maintained for a second, and, therefore, whether this was instantly followed by a reverse application (as appears to have been the case), or by the establishment of a connexion with the ground, the law of squares ought to be verified very closely for all lengths of cable less than 300 miles, if the battery power is arranged so that the maximum strength of the

current is in all cases the same. Accordingly, we have a tolerable verification of the law of squares by Mr. Whitehouse's observed retardations in the 166 mile and the 249 mile cable, which are respectively ·14 and ·36. These show an even greater increase of retardation in the greater length than according to that law, which would have been exactly verified by the numbers ·14 and ·315. If the indicating instrument does not show its effect until a somewhat larger proportion than $\frac{3}{4}$ of the maximum strength is reached, the retardation in 498 miles may be either more or less than twice the retardation in 249 miles; and if it be only little more than twice (being ·79 as Mr. Whitehouse finds it), it will follow from the theory as illustrated by the table that the retardation in 996 miles ought to be found considerably less than twice the retardation in 498. Thus Mr. Whitehouse finds even the retardation in 1020 miles less than the double of the retardation which he finds in 498 miles. Another cause which may contribute to deviations from the law of squares, and which must most seriously derange the results from agreement with any easily calculated indications of theory, is the inconstancy of the galvanic battery employed. It is well known to all who have used the sand-battery, or any other form of battery which evolves gaseous hydrogen during its continuous action, that, in commencing to act after having been quiescent for any time, it acts with immensely greater electro-motive force than it can keep up, and that during the initial second of its operation the electro-motive force *falls in general with great rapidity*. This circumstance it is probable, largely influences the phenomena which Mr. Whitehouse observed; and if it does, must complicate extremely the character, both relative and absolute, of the electrical operations used in his experiments on different lengths of cable.

It appears then, that in the one case of comparison in which a manifestation of the law of squares could be expected, that law is manifested by Mr. Whitehouse's results, and that in all other cases, so far as the data supplied suffice for testing, they agree with the theory of which the law of squares is a part.

To test the theory extensively and strictly by observations with Mr. Whitehouse's instruments will, probably, not be easy without using either a constant battery or a system of measured electro-magnetic impulses. It will, however, I have no doubt, be quite practicable with a sufficient number of cells of Daniell's battery to verify the law of squares with considerable precision for lengths of cable from 498 miles upwards. All that will be necessary will be to take such battery powers as to give the same permanent current through the cable and instrument in the different cases, that is to say, to make the numbers of cells used proportional to the lengths of the cable; and in each experiment to hold on the battery connexion until after the indicating instrument has made its mark. The most favorable relation between the sensitiveness of the indicator and the battery power, to give a sharp test, is such that the full strength of the permanent current is about four times the strength that just moves the index. But this would probably give too small a retardation in the 498 mile cable to free the comparison from large influence of electro-magnetic induction in the coils, and it may be that a more satisfactory test would be obtained with the actual instruments, by using battery power

capable of maintaining a permanent current more by only ½d or ¼th than enough to give an indication.

2. *Influence of Lateral Dimensions of Conductor and Insulating Tube on Rapidity of Electrical Action.*—My remedy for inconvenient slowness of action in a submarine cable is an increased diameter of conductor and of gutta percha coat, in the same proportions, or in different proportions, indicated by economical considerations calculable from theory with data as to the price of copper, gutta percha, and iron, and the relative expense and risk in laying cables of different weights (see my first communication on the subject referred to above). Until the price of copper comes to be a serious consideration in comparison with the whole expense of making and laying the cable, an increase in the diameter of the conductor alone, up to a certain limit, without any increase in the thickness of the gutta percha tube, may be the cheapest remedy. Accordingly, in my statement quoted by Mr. Whitehouse, either on thick copper wire, or (as is preferable for mechanical reasons) "a number of small wires twisted together" is recommended to obviate inconvenient slowness of utterance. Mr. Whitehouse tests this proposal by three wires connected at their ends so as to afford a tripple conducting channel, *but separated throughout their lengths by their gutta percha coats.* Now it is perfectly clear that an electrical impulse through three wires so arranged cannot differ from the sum of three separate electrical impulses of one-third strength each through any one of the wires, except in virtue of mutual peristaltic induction. With these very wires Mr. Whitehouse found the effects of mutual peristaltic induction to be extremely slight, requiring some of his finest tests to be shown at all. How then he found "the retardation nearly twice as great with the triple wire as in one of the wires alone," is an anomaly which it is not my part to explain. I may be allowed to suggest as a possible explanation, that he used only battery power enough to give the same permanent current through the triple wire as through the single wire in the comparative experiments, and that the triple conductor exhausted the high initial electro-motive force much more rapidly during the first quarter of a second than the single wire. In reality, when justice is done to the triple wire, it will be found to transmit the action *a very little more rapidly than one wire alone;* in consequence of the diminution of electrostatic capacity in each wire, which is caused by mutual induction among the three when equal neighboring parts of them are similarly and equally electrified at each instant. But my law regarding the effect of increasing the diameter of one wire or of using *a number of fine wires twisted together*, is neither proved nor disproved by experiments on the combined effects of a number of wires about as widely separated from one another as from their common iron sheath.

Neither on the two points to which I have especially adverted, nor on any other, will it be possible, I believe, to find the theory at fault; and Mr. Whitehouse has too effectively proved himself to be a sincere searcher for truth to allow me to doubt that he will sooner or later fully admit the correctness of my conclusions, although they have hitherto appeared to him to be at variance with the phenomena he has observed.

On the other hand, I have much pleasure in admitting that he has quite answered my objections to experiments on the retardation of effects of a

current sent through a certain length of wire backwards and forwards in a "multiple" cable, as trustworthy for indicating the retardations to be expected in the same length of wire laid out singly to an untried distance. I am very glad, too, to perceive that he has succeeded in convincing practical men by his experiments, in conjunction with Mr. Bright and Mr. Morse, that a cable of ordinary lateral dimensions may be not too slow in its action for commercial success in the projected sub-Atlantic telegraph.

I should certainly not have expected that this would be found to be the case *if the Varna and Balaclava telegraph, when pushed to the utmost, had been found to be inconveniently slow;* but although I have never been able to learn any particulars as to the experience of those who have worked that telegraph, I have the best possible reason now for knowing that if nine letters per second have not been delivered by it, the fault, or rather I should say the deficiency, has not been in the cable, but in the instruments. Measurements published since the beginning of the present year by that most profound and accurate of all experimenters, Wilhelm Weber, have allowed me to reduce his own previous determination of the electrical conductivity of copper to the proper kind of unit for the telegraph problem, and have so afforded me the data for calculating the retardations of electric signals sent through a copper wire of stated dimensions, insulated in any specified manner. I thus find that the retardation of the maximum strength at one extremity, consequent on a single instantaneous electrical impulse at the other extremity of 400 miles of Black Sea cable,* amounts to only about ·117 of a second. The corresponding retardation in a cable of equal lateral dimensions, and 2400 miles long, would be only about 4·2 sec. A mode of operating so as to clear a wire rapidly of residual electricity, which I have worked out from theory, and a plan for telegraphic receiving instruments to take the most full advantage of it which has recently occurred to me, allow me now to feel confident of the possibility of sending a distinct letter every $3\frac{1}{2}$ seconds by such a cable. This, amounting to 17 letters per minute, would give 200 messages of twenty words in the 24 hours, and at 30*s.* a message would be not a bad return for 1,000,000 *l.* of capital expended. The rate could be augmented to a letter every $2\frac{1}{4}$ seconds, or 280 messages in 24 hours, by augmenting the diameter of copper and gutta percha tube each in the proportion of 5 to 4,—that is to say, by using a copper conductor $\frac{1}{12\cdot4}$ of an inch diameter, in a gutta percha tube $\frac{5}{16}$th of an inch outer diameter.

From the letter in the *Daily News* (Oct. 9), I can form no idea of the rate which the experiments on the 2000 miles of cable promise for the delivery of the messages. That letter gives no information whatever which could not have been told ten years ago without experiment,† and which was not actually asserted by myself a year and a half ago,—except this, that the eminent men who directed and assisted in those experiments saw something that convinced them of the practicability of telegraphing, at a rate commercially advantageous, between Newfoundland and Ireland, by means of a cable of such dimensions and arrange-

* Or a single wire cable; copper wire $\frac{1}{15\cdot4}$ of an inch in diameter, in gutta percha tube $\frac{1}{4}$-inch external diameter.

† See my last letter to the *Athenæum*, published October 4.

ment as that on which they made their experiments. If they can satisfy themselves that the effects of mutual induction between wires in a multiple cable of such a length will not be injurious, and that the rates of telegraphing which they can accomplish are as good as those I have indicated, then a multiple cable, such as that proposed by Mr. Whitehouse (*Athen.* Aug. 30, p. 1093), will be undoubtedly satisfactory. But the effects of mutual induction between three or four wires in a cable 2400 miles long will be decidedly more embarrassing in rapid operations than they have been found with shorter lengths; and even without the new plans of working to which I allude may be found so inconvenient that single wire cables will be preferred. If these new plans of wires are to be used, it may be necessary to have only one wire under one iron sheath, as I fear they would not succeed in a multiple cable, although on this point I cannot yet speak with confidence.

I shall only say, in conclusion, that I intend to prepare and publish a table of different sets of dimensions for cables, with estimated rapidity of transmitting messages by each, which those engaged in projecting the Ocean Telegraph may find useful if their experiments leave anything undecided as to the best plan of cable for their purpose, if they have any confidence in scientific deductions from established principles.

Invercloy, Isle of Arran, Oct. 24.

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*On Nature Printing.** By Henry Bradbury, Esq., M. R. I.

(Continued from page 47.)

During the next twenty years Nature Printing was but indifferently prosecuted by various persons for various purposes. Mr. Taylor, of Nottingham, as far back as 1842; printed lace, &c., specimens of which were exhibited at the Great Exhibition; and Mr. Twining, of Nottingham, in 1847, printed ferns, grasses, and plants, which were exhibited by the Botanical Society of London. He adopted the same plans as those used by Kniphof and Hoppe.

In 1847, also, Dr. Furguson Branson commenced a series of experiments, an interesting paper upon which was read before the Society of Arts in 1851, and therein for the first time was suggested the application of that second and most important element in Nature Printing, which is now its essential feature—the application of the Electrotype.

"I beg leave," says he, "to bring before the notice of the Society of Arts a new method of engraving plates for printing ferns, leaves, sea-weeds, and other flat plants. . . . . Having taken in gutta percha some impressions of ferns, the singularly beautiful manner in which the exact character of the plant was transferred to the gum, suggested to me the possibility of printing from the gutta purcha itself, so as to produce on paper a *fac-simile* of the plant. That experiment partially succeeded, and curiously tested the elasticity of the substance; for the impression remained uninjured, after being subjected to the great pressure of a copper-plate roller. I say that it *partially* succeeded; for the printer found it utterly impossible so thoroughly to cleanse the

* From the Royal Institution of Great Britain.

ink from the margin around the impression, as not when printed to leave a dirty stain on the paper. The impressions thus produced were very accurate; but the process was valueless as regards multiplication of the prints."

It then occurred to Dr. Branson that an electrotype copy would obviate the difficulty.

He afterwards stated that he abandoned the process of electrotyping in consequence of his finding it tedious, troublesome, and costly, to produce large plates. Having occasion, however, to get an article cast in brass, he was astonished at the beautiful manner in which the form of the model was reproduced in the metal. He determined, therefore, to have a cast taken in brass from a gutta percha mould of ferns, and was much gratified to see the impression rendered almost as minutely as by the electrotype process;* but, however curious his individual specimens, the process produced no practical result.

In 1849, Professor Leydolt, of the Imperial Polytechnic Institute at Vienna, availed himself of the resources of the Imperial Printing-office to carry into execution a new method he had conceived of representing agates and other quartzoze minerals in a manner true to nature. Professor Leydolt had occupied himself for a considerable period in examining the origin and composition of these interesting objects in geology. In the course of his experiments and investigations he had occasion to expose them to the action of fluoric acid, when he found, in the case of an agate, that many of the concentric scales were totally unchanged, while others, to a great extent, decomposed by the acid, appeared as hollows between the unaltered scales. It occurred to Leydolt that the surfaces of bodies thus corroded might be printed from, and copies multiplied, with the greatest facility.

The simplest mode for obtaining printed copies is to take an impression direct from the stone itself. The surface after having been etched is well washed with dilute hydrochloric acid and dried; then carefully blackened with printer's ink. By placing a leaf of paper† upon it, and by pressing it down upon every portion of the etched or corroded surface with a burnisher, an impression is obtained, representing the crystallized rhomboidal quartz *black*, and the weaker parts that have been decomposed by the action of the acid *white*. It requires but a small quantity of ink—and particular care must be exercised in the rubbing down of the impression. This mode is good as far as it goes—but it is slow and uncertain—and incurring a certain amount of risk, owing to the brittle nature of the object; and the effect produced is not altogether correct, since it represents those portions black that should be white, and those white that should be black.

The stone is not sufficiently strong to be subjected to the action of a printing-press; an exact *fac-simile* cast, therefore, of it must be obtained, and in such a form as can be printed from. To effect this, the surface of any such stone (previously etched by corrosion) must be extended by imbedding it in any plastic composition that will yield a perfectly flat

* The casting in brass is a very interesting experiment—but its results cannot be compared with the production of the electrotype.

† *India-paper* and *Chalk-paper* are the best adapted for the purpose.

and smooth surface, so that the surrounding surface of the plastic composition will be exactly level with the surface of the etched stone: all that is necessary now is to prepare the electrotype apparatus, by which a perfect *fac-simile* is produced, representing the agate impressed, as it were, into a polished plate of copper. This forms the printing plate. The ink in this case, as opposed to the mode before referred to, is not applied upon the surface, but in the depressions caused by the action of the acid on the weaker parts; the paper is forced into these depressions in the operation of printing, which results in producing an impression in relief—a feature that is rather peculiar to the process, as the raised appearance, especially in the case of plants, adds very much to their effect.

The impressions printed in this latter manner present far more beautiful and natural representations, since the crystallized quartz are represented *white*, while the decomposed parts appear *black*.

Professor Leydolt, however, suggests that some corroded stones are better suited sometimes for one method of representation than the other; and attention should be paid to this while the stones are being exposed to the action of the acid. He considers that important advantages will result to science from the perfect faithfulness of such representations, and from the facility and inconsiderable expense of their production.

Other objects in geology—such as the fossil remains of fishes, plants, and other organic remains—in some cases can be, and have been, copied with unmistakeable resemblance to the original.

It is not clear who may have suggested the possibility of creating impressions of these last-named objects, but one thing is beyond a doubt, that the production of them was left entirely to the judgment of Andrew Worring, as was also the case in the production of the agates and other stones.

In operating upon this class of objects, it is desirable that the original should be as flat as possible, as the flatter the general surface is, the more successful will be the effect produced.

A mould in the first place is taken with gelatine or liquid gutta percha, the elasticity of which materials are favorable for flattening the mould without distortion when separated from the original,—a mode that is to be preferred to depositing copper direct upon them, since it is very much more easily manipulated, and without the slightest risk of damaging the originals, owing to the absence of pressure.

This gelatine or gutta percha mould is rendered metallic or conducting in the usual way by the application of plumbago, and copper is deposited until of sufficient thickness to form a printing plate.

In 1852, Mr. Aitken, of Birmingham, followed the footsteps of Kyhl in various experiments made by him in Britannia metal. He took impressions of lace, skeleton-leaves, feathers, &c., in Britannia metal, for the purpose of ornamentation, in the same way as Kyhl is said to have done in articles of silver. About this period Dr. Branson again made experiments, and endeavored to bring Nature Printing into practical operation. He too tried impressions on Britannia metal, not altogether with the view of printing direct from such plates, desirable as it would be to dispense with the operation of taking casts—but of transferring impressions to stone; and after printing an impression in some neutral tint, to

resort to coloring by hand. (Specimens of this method were lying on the table; but, on examination, would not bear comparison with the productions of the present time.)

In the Imperial Printing-office of Vienna, the first application of taking impressions of lace on plates of metal, by means of rollers, took place in the month of May, 1852:* it originated in the Minister of the Interior, Baumgartner, having received specimens from London, which so much attracted the attention of the chief Director, that he determined to produce others like them. This led to their using gutta percha in the same way that Dr. Branson had used it; but finding this material did not possess altogether the necessary properties, the experience of Andrew Worring induced him to substitute lead, which was attended with remarkable success. Professor Haidinger, on seeing specimens of these laces, and learning the means by which they had been obtained, proposed the application of the process to plants. The results of these experiments,† as well as those of Professor Leydolt above referred to, appeared in the fifth volume of Memoirs of the Imperial Academy, published at Vienna, in 1850.

Up to this time, however, in England, notwithstanding the abovementioned experiments, the discovery had not assumed any practical form; but there is little doubt that if any of these persons had had the requisite means and appliances it would have been brought to perfection earlier. These consist mainly in the precipitation of metals upon moulds or matrixes by means of electro-galvanic agency.

Nature Printing owes it present success to the electrotype, which was then, and even at the present time is, the only means by which *faithful* copies can be taken of those delicate fibrous details that are furnished in the examples of the impressions of botanical and other figures in metal. It may be said to be owing to the extensive scale upon which the process of the electrotype is conducted in the Imperial establishment, that Worring was enabled to render the process of Nature Printing practically available as a Printing Art.

The deposition of metals by galvanic agency, though long known and practised in England, has been considered more as a *scientific* than a *practical* mode of casting; and it is only within the last few years that its value in its manufacturing capabilities has been properly understood. Up to within a short time it has been found uncertain, difficult, tedious, expensive, and requiring great length of time to obtain adequate results from it; but Mr. Bradbury stated, that he had for the last two years devoted his energies to overcome these difficulties, and that his experiments had been attended with many practical advantages in the Art of Printing. On the table before him he had a small electrotype apparatus, by which was produced a perfect electrotype cast of an impressed metal plate before the audience in half an hour.‡ He stated, that one of his

* The Austrian patent was taken out on the 12th October, 1853, in the name of Andrew Worring.

† These consisted of specimens of lace, leaves, plants, mosses, serpent skins, the wing of a bat, agates, fossils, and petrifactions; and it is somewhat curious that these examples were similar in character to those chosen by Kyhl.

‡ In the afterpart of the evening Mr. Bradbury succeeded in producing thin electroplates of impressed plates in five minutes.

experiments had been crowned with such success, that he had reduced the operation of the battery and the decomposition trough to so rapid and certain a result as to be able to duplicate the woodcuts contained in a number of the *Illustrated London News*, no matter what their number or size, in the short space of twelve hours (ready in every respect for the press), which he stated as his belief, was one of the greatest practical accomplishments that had ever been made in any country in this branch of science; the value of which to the journal in question will be best understood when it is known, that without *this* or other means (not yet discovered), the production of the requisite number of copies in time for publication, would be a mechanical impossibility, (so extensive is its circulation,) since from *one* set of engravings there is a limit to the number of impressions that can be printed from *one* machine in a given time.

The mode of printing these electrotype* plates of plants is the same as in the ordinary copper-plate printing, where the impression is produced by passing the inked plate with the sheet of paper laid upon it through a pair of rollers, one of which is covered with four or five thicknesses of blanketing, which causes the peculiar raised or embossed appearance of the impression.

In such cases, where there are three, four, or more colors, for instance, —as in flowering plants, having stems, roots, leaves, and flowers,—the plan adopted in the inking of the plate is to apply the darkest color first, which generally happens to be the roots—the superfluous color is cleaned off,—the next darkest color, such as perhaps the color of the stems, is then applied—the superfluous color of which is also cleared off,—this mode is continued until every part of the plant in the copper-plate has received its right color. In this state, before the plate is printed, the colors in the different parts of the copper, look as if the plant was imbedded in copper. By putting the darkest color in at the beginning, there is less chance of smearing the lighter ones: the printer too is not only able by this means to blend one color into another, but to print all the colors at one single impression.

The *first* practical application of Nature Printing for illustrating a botanical work, and which has been attended with considerable success, is Chevalier Von Heufler's work on the Mosses,† collected from the Valley of Arpasch, in Transylvania; the *second*, (the *first in this country*,) is the "Ferns of Great Britain and Ireland," in course of publication, under the editorship of Dr. Lindley, and printed by Messrs. Bradbury & Evans. Ferns, by their peculiar structure and general flatness, are especially adapted to develop the capabilities of the process, and there is no race of plants where minute accuracy in delineation is of more vital importance, than the Ferns; in the distinction of which, the form of indentations, general outline, the exact manner in which repeated subdivision is effected, and most especially the distribution of veins, scarcely visible

* The copper deposited upon moulds by electro-galvanic agency, is precipitated in such inconceivably small atoms, that the defects previously referred to in the surface of the lead plate, are also *faithfully* copied, but the surface of copper (unlike that of lead) will allow of these defects being removed by the aid of the burnisher, and a polished surface preserved.

† *Specimen Floræ Cryptogamæ vallis Arpasch Carpatæ Transylvani;* Conscripsit Ludovicus Eques de Heufler. Vienna, 1853. Imp. folio.

to the naked eye, play the most important part. To express such facts with the necessary accuracy, the art of a Talbot or a Daguerre would have been insufficient until Nature Printing was brought to its present state of perfection.

Mr. Bradbury then adverted to the ingenious and beautiful productions of Felix Abate, of Naples. His Nature representations consist of sections of wood, in which the grain is admirably represented. He terms his peculiar process Thermography, or the Art of Printing by Heat. The process consists in wetting slightly the surface of the wood, of which *facsimiles* are to be made, with any diluted acid or alkali, and then taking an impression upon paper, or calico, or white wood; the impression is quite invisible, but by exposing it for a few instants to a strong heat, the impression appears in a more or less deep tone, according to the strength of the acid or alkali. In this way every gradation of brown from maple to walnut, is produced; but for some woods which have a peculiar color, the paper, &c., is to be colored, either before or after the impression, according to the lightest shades of the wood. Abate, in his manipulations, also employs the ordinary dyeing process.

It is to be hoped that Abate's process may become alike useful to the natural sciences and the decorative arts.

Mr. Bradbury stated in conclusion, that we are indebted to—

Kniphof, for the application of the process in its rude state;
Kyhl, for having first made use of steel rollers;
Branson, for the suggestion of the electrotype;
Leydolt, for the remarkable results he obtained in the representation of flat objects of mineralogy, such as agates, fossils, and petrifactions;
Haidinger, for having promptly suggested the impression of a plant into a plate of metal at the very time the *modus operandi* had been provided;
Abate, for its application to the representation of different sorts of ornamental woods on woven fabrics, paper, and plain wood;
Worring, of the Imperial Printing-office, Vienna,* for his practical services, in carrying out the plans of Leydolt and Haidinger.

Nature Printing may be considered as still in its infancy; but the results, already obtained in its application, encourage us to expect from continued efforts, such further improvements as will place it not least among the Printing Arts. [H. B.]

The New American Steamships of War.†

The visit of the large American steam frigate *Merrimac* to Southampton having occasioned considerable interest, we think it may now be a proper time to lay before our readers such information as we have from time to time obtained respecting her, and the *Wabash*, the *Minnesota*, the *Roanoke*, and the *Colorado*—four ships of much the same size and power as

* It is gratifying to know that the services of this gentleman, were recognised by his Sovereign, who munificently rewarded him with a gift, and likewise the Order of Merit.

† From the Lond. Mech. Mag., October, 1856.

the *Merrimac*—and also respecting the huge steam corvette the *Niagara*. In order to render the information which follows perfectly reliable—in so far at least, as the *Merrimac* is concerned—we have visited that vessel, and verified by personal observation the facts hereafter stated. In making this verification we were favored with the utmost courtesy and co-operation on the part of the officers of the ship, and particularly of First Lieutenant G. W. Harrison, who was in command of her at the time of our visit, and to whose kindness we are much indebted.

The principal dimensions of the five frigates above enumerated are so nearly alike that they may, for all ordinary purposes, be considered the same, and may be taken as follows:—*

Length on keel,	250 feet.	
" " load water line,	260 "	
" over all,	300 "	
Breadth extreme,	51 "	4 inches.
" moulded,	50 "	2 "
Depth of hold (to gun deck),	26 "	4 "
Draft of water forward,	23 "	6 "
" " aft,	24 "	

As our examination of the *Merrimac* was made for the purpose of estimating her merits as a ship of war, we must add to the above the following details, which are of importance in such a ship. When the vessel is at her load line, the heights of the gun deck ports above the water are amidships 9 feet, and forward and aft 12 feet, or thereabouts. The height from her gun deck to the lower sides of her spar deck beams is 6 feet. The height of her bulwarks is such that, when the hammocks are stowed, they reach 8 feet 8 inches above the upper deck. Her gun deck ports are 3 feet 8 inches long, and nearly 8 feet 6 inches apart. Her load displacement is estimated at 4000 tons; but this we could not, of course, test.

The *Merrimac* was designed by Mr. Lenthall, who is at the head of the Bureau at Washington,† and was built by Mr. Delano, the master

* Almost the only difference between the dimensions of these five frigates is a slight one in their lengths. But this is a difference of about five feet or six feet only at most. The *Wabash* is said to be 5 feet 8 inches longer than the *Merrimac*; but even this is true only when the length is measured at the load line.

It may be well to state here that we are in possession of numerous statistics relating to these ships, which we have not thought it necessary to give, because they can only be of use to the constructors of ships of war, who do not trust to scientific journals for the elements of foreign vessels. We see no utility in publishing, in isolated cases, such quantities as the height of the metacentre, and the moment of stability, for instance. We consider that their publication, under such circumstances, is always pedantic, and are confident that they are frequently given in absurd forms. Only recently we saw in a contemporary, among the statistics of the *Niagara*, these words:—"Movements of stability ($8\frac{1}{3}\ y^3\ ax$), 2,415,560 sq. ft." This was probably intended to be, "Moment of Stability ($\frac{2}{3}fy^3\ dx$), 2,415,560." But even this is, of course, wrong; every naval architect knows that the quantity $\frac{2}{3}fy^3\ dx$ is not the moment of stability, but the moment of inertia of the load water section.

† The four sister ships were also designed by Mr. Lenthall. The American *Nautical Magazine* says, "In the appropriation for these six auxiliary steamers there was one prominent exception. Congress determined that one of these ships should be constructed by a private builder, and Mr. George Steers, the constructor of the yacht *America*, was entrusted with her construction; while the other five were left in the hands of the Bureau of Construction, perhaps that their models might indicate their origin."

shipwright of the Navy Yard at Boston (or the officer who corresponds to a master shipwright of our own dockyards). Her frame is of live oak, crossed on the inside with two sets of diagonal iron plates which are inclined in opposite directions. She is also strengthened by similar plates on the outside at bow and stern. Her plank is also of oak, and, like our own ships of war, she is copper-fastened up to a few feet above the load water line. Her decks are of fir. On a careful inspection, she seems to have been built with very great skill and care, and is a very tight, strong ship. The large wooden knees (common in American ships because more approved of, and more readily obtained than iron,) to some extent interfere with the beauty of her appearance inboard. But she is a very roomy and handsome ship, and the appearance of her main deck is unsurpassed.

With all her sails set, she spreads 56,629 square feet of canvass. Her engines are auxiliary only. Her rig is in all respects like that of the largest American sailing frigates, but from her great length she seems capable of carrying masts, spars, and sails even larger than those she has. The mode in which the mainmast steps is worthy of attention. The shaft of the propeller coming immediately beneath it (since the engines are before the mainmast), a step is formed to receive it above the shaft. This step consists of a large thwartship beam of live oak, supported near the middle by two 12-inch solid iron columns which rest upon suitable keelsons. This arrangement is perhaps as good as any other, although the strength attending it must certainly be much less than that in which the mast steps in a wooden step supported immediately by the keelsons themselves, as is the case where no screw shaft interferes. The modes adopted in our own navy are various. In some cases tall iron forked steps, which stride across the shaft, are employed, and in others the heel of the mast itself is enlarged, and the shaft allowed to pass through it, the lower piece of the mast being separable from the upper, and connected with it by clasp-jointed hoops.

The *Merrimac* is pierced for 60 guns, but if she were actually to carry that number, they would have to be of a lighter character than those now on board of her. Her present armament is as follows:—On her upper deck there are two large pivot guns, each weighing nearly 5½ tons and of 10 inches bore, and fourteen 8-inch guns, each weighing rather more than 3 tons; on her gun deck there are twenty-four 9-inch guns, each weighing nearly 4½ tons. The whole of these guns, forty in all, though strong enough to discharge solid shot, if desired, are primarily intended to be served with hollow shot, or with shell,—for it is now a practice with the Americans to supply their navy with a quantity of empty hollow shot, which may be either plugged and used as such, or charged, fitted with fuzes, and used as shells. We must not, however, omit to mention that she might carry a few additional 9-inch guns on the main deck with perfect convenience. Her gun carriages on the main deck are similar to those used in the French navy. They have, however, but two wheels or trucks each, at the ship's side end of the carriage. To facilitate the running out of the gun, the rear end of the carriage is raised by a handspike fitted with a roller at the end, on which roller the car-

riage runs out. At the upper side of this handspike roller is a pin or stud, which takes into one or other of a series of recesses formed in a plate on the underside of the rear end of the carriage. The carriage slides of the large pivot guns differ from our own chiefly in the fact that they are furnished at each end with wheels or trucks (which run on the metal circular bearing plates on the deck) mounted on eccentric axles. These axles are turned by a spanner, so as either to take the weight of the slide and allow it to be run round upon them, or to be raised clear of the bottom of the slide, and allow it to rest immediately upon the deck plates. The carriages which run upon the slides have their rear trucks mounted upon similar eccentric axles. The friction of the carriage upon the slide when the piece is to be discharged (and when the trucks are clear of the slide,) is sometimes increased by nipping the two together with screws.

The whole of the 9-inch guns, or main-deck guns, as well as the two 10-inch pivot guns, are formed upon Commander Dahlgren's system, which consists in giving to the gun, at each point of its length, a thickness proportioned to the direct pressure of the powder in the chase at that point, supposing the gun to be fired with an ordinary service charge. In order to carry out that principle, Commander (at the time Lieutenant) Dahlgren took an ordinary paixhan gun, and had bored in it a number of holes, each of the size of a musket ball, extending from the outside of the gun through into the chase. These holes were perpendicular to the axis of the gun. A musket ball was then placed in the first hole (the remainder of the holes being plugged for the time), the gun fired with a service charge, and the initial velocity communicated to the musket ball measured by a ballistic pendulum. This was repeated with each hole successively, and lines representing the initial velocities thus obtained were taken as the ordinates of a curve (of which the distances apart of the holes represented the abscissæ), and this curve gave the contour of the exterior of the gun. The Dahlgren guns are of greatly reduced thickness along the chase, and suddenly increase their thickness near the breech, where the great bulk of the metal of the gun is collected. Before the adoption of them in their navy, the American government had them severely tested, with highly satisfactory results. Without doubt, the principle of Commander Dahlgren is correct, so far as it goes. There are also collateral advantages connected with the adoption of it in naval ordnance, one of which is that the centre of gravity of each side battery is, owing to the form of the guns, thereby brought nearer to the middle of the ship, which must tend to make her roll less heavily than otherwise. Each gun is furnished with two lock-lugs, or lugs for the gun-lock—one for use, and one to supply its place if it should be knocked away.

There are a few other novel features in connexion with the guns of the *Merrimac*. One is that her guns are fitted with elevating screws, which supply the place of the *coin*, &c., in our own service. This arrangement tends greatly to facilitate the sighting, and is certainly an improvement, provided that it is not attended with any defect in strength, and we were assured that none had been observed during considerable practice. Another new feature is the employment of bristles, instead of

sheepskin, in all the sponges and rammers for the guns; and a further one is the employment, for boat guns, of light and elegant wrought iron carriages, of which she has three, one for a 9-pounder, a second for a 12-pounder, and a third for a 24-pounder.

The engines of the *Merrimac* are by Mr. Parrott, of the Cold Springs Foundry, New York. She has two cylinders 72 inches in diameter, and 3 feet stroke. These are placed close to the shaft, on opposite sides of it, leaving room only for the crank. Each piston has two piston-rods, one above and one below the shaft; these carry a cross-head, from which the connecting rod reaches back to the crank, as is well understood by engineers. Each cylinder has its condenser at the side of it, and its air-pump opposite to it. The air-pump rods go through the cylinder ends direct to the piston. She is fitted with four of the vertical tubular boilers patented by Mr. D. B. Martin, Engineer-in-chief of the U. S. Navy, similar to those fitted previously in the *Susquehanna*, by Merrick & Son, of Philadelphia. The boilers are of iron, with brass tubes, and have the following general dimensions:

Length of each boiler, athwartships, 11 feet; breadth, fore and aft, 14·8 feet; length of vessel occupied by four boilers, 31 feet 8 inches; breadth of ditto, and fire-room, 31 feet. The fire-room is between the two pair of boilers, the furnaces firing athwarships, and the flues delivering into one chimney. Height of boilers, 13 feet 6 inches; cubical space occupied by all the boilers and fire-room, being the content of a parallelopipedon included within the above circumscribing lines, 13,240 cubic feet; number of furnaces in all boilers, sixteen; breadth of ditto, each, 2 feet 10½ inches; length of ditto, each, 7 feet; grate surface area in all, 338 square feet; number of tubes in all boilers, 5480; length (or height), 37¾ inches; diameter (outside) of the tubes, 2 inches; heating surface in furnaces and back connexions up to tubes, 1614 square feet; heating surface in tubes, 8508 square feet; heating surface in tube-boxes and connexions to smoke chimney, 1581 square feet; total heating surface in all boilers, 11,703 square feet; proportion of the same to grate area, 34·6 to 1·00; flue area or calorimeter between tubes in all boilers, 42 square feet; proportion of the same to grate area, 1 to 8 square feet; diameter of smoke chimney, 8 feet.

The boilers all have water-bottoms, with not less than 6 inches of water-space at any point; back of the furnaces these bottoms rise to the back connexions; the tube-boxes are above the furnaces, and rise about 3 inches to the front end of the boiler, where they enter the front connexions. The boilers are of ⅜th inch and ½ inch best American plates, double riveted and caulked inside and out, throughout, and are well braced. The weight of all four, when empty, is 255,000 lbs. Their total weight, when filled to the working level, is 440,000 lbs.

To test the economical evaporative efficiency of this form of boiler, an experiment was made on the 13th of March last, in the presence of several engineers of the navy, the conditions and results of which were, as published by Mr. Merrick, the maker, as follow:

Two boilers only were used, and the dampers were nearly closed.

The coal used was anthracite, and of an inferior quality. The engines

are fitted with Stevens' cut-off, which was adjusted and permanently fixed to cut off as follows:

Port engine, one end, . . .	3·88
" " . . .	4·12
Starboard engine, one end, . . .	4·60
" " . . .	3·35
Average per indicator card, with full throttle, .	3·97 feet.
Adding to this the average clearance at each end of the cylinder, and including, also, the steam passage, &c., between valves and cylinder, equal to 23·820 cubic inches, or the area of the cylinder by 6·05 inches* of stroke, or . .	·504 "
Average length of cylinder, filled at each single stroke,	4·474 "

Preserving the same level of water in the boilers, and (as nearly as could be ascertained) the same quantity of coal in the furnace, or about the same fires, and maintaining the same pressure of steam, 4200 lbs. of coal were consumed, and 1615 revolutions made and noted by register, the duration of the experiment being 3 hours 57 minutes. During this time eleven double cards were taken on the two engines, which showed a mean pressure of steam entering the cylinders, during that part of the stroke over which steam was admitted of—

Total pressure—Port engine, 18·99 lbs.; starboard engine, 21·81 lbs., of which (Pambour) the volume is 1257.

Hence, the water evaporated during the experiment was as follows: the two cylinders being 70 inches diameter = 26·41 square feet of area.

$$\frac{26{\cdot}71 \times 4{\cdot}74 \times 1615 \times 4 \times 62{\cdot}5}{1257} = 39{,}372 \text{ lbs of water.}$$

which, being evaporated by 4200 lbs. of coal, gave 9137 lbs. of water per lb. of fuel.

The temperature of the hot-well was 89½°, and of the feed-water entering the boiler at (probably) 85°. The evaporative power of the boilers will at once be seen from the above figures of Mr. Merrick. In the *Merrimac* very excellent results have also been obtained with Mr. Martin's boilers. Her coal bunkers carry about 600 tons of coal. A small pair of donkey engines are provided on the main deck for coaling, raising heavy weights on board, &c. These auxiliary engines have a suitable boiler to supply them when the main boilers are not at work. Two steam pumps are fitted in connexion with the large engines for pumping out the bilge, extinguishing fires, &c. These steam pumps may be supplied with steam from the auxiliary boiler, if desired. The *Merrimac* is fitted with a Griffith's screw propeller, with means of varying the pitch. In this respect she differs from her sister ships, all of which have ordinary propellers. The *Niagara* is, we understand, to have a Griffith's.

The propelling arrangements on board the *Merrimac* are very complete. The forward thrust is taken by a series of collars, and the backward thrust by a brass disk dropped down between the end of the propeller bearing and the after stern post. This disk may be readily renewed when worn. The shaft is supported between the engines and the dead wood by bearings and intermediate spring supports, and a cooling pipe is led from the

* This enormous amount is taken from actual measurement, and is stated to be, in a great measure, incident to the form of engines (inclined) with which the ship is supplied.

outside of the ship over each. The after propeller bearings are of wood, upon Penn's principle. The propeller is raised by a cable and pulleys, the cable leading to the capstan. A long wooden stay, tightened by a screw, is used for keeping the propeller down in its place, and suitable means are also provided for steadying the propeller during the raising of it, for slinging it when raised, or partially raised, &c.

The greatest speed ever attained by the *Merrimac* under steam alone was seven knots per hour, and this was made under very favorable circumstances. Her average steaming speed is much less than this. There are, however, certain defects in connexion with her slide-valves which prevent the full and economical results being attained with her engines. The lap and lead was so small, that at first she could not cut-off her steam until 19 inches of her stroke: she will, for the future, owing to improvements made on board, cut-off at 15 ins. But radical changes must be made in her valves before the necessary economy is obtained. The details of the engines—the driving gear, &c.,—are very well arranged.

The *Merrimac* is full of evidences that the American government are willing to give trial to improvements of a promising character in their ships of war, notwithstanding the changes which their introduction renders necessary. At the same time there are arrangements, which have been proved highly valuable in our own service, unadopted by them. For example, instead of the admirable lightning conductors of Sir W. Snow Harris, used with so much advantage by us, the old bit of chain long discarded here, lies down against her shrouds, and gives great offence to the eye of the intelligent visitor. But, on the whole, the useful improvements greatly out-number the defects. This we might show at great length if we thought it desirable. It will, however, be sufficient to add a further fact or two. The fish-davit is centered on a hoop on the foremast, and may be swung over either anchor for fishing it, and may also be used to assist in the removal of the heavy berthing which has to be taken down when the bow pivot gun is used. Both operations may be performed by steam power derived from the auxiliary engines. Another useful arrangement is the use of a hinged tongue-piece, which may be pressed down between the links of the cable by a screw when the cable has to be fleeted. Another is the employment of light bulkheads around the engine-room hatches on the main deck. Whether the absence of all mess tables for the ship's crew is an improvement or an act of retrogression, we leave naval officers to decide.

In our next number we shall probably publish a few further statements respecting the *Merrimac*. At the same time, we believe that the points of chief importance are included in the above remarks.

The *Niagara* is built, we are told, as an experiment; and it is perfectly certain that if she should prove a thoroughly strong and efficient ship of war, she will surprise every one who has hitherto been considered well informed on the nature and requirements of war ships. The history of this ship's origin is simply this:—Mr. Steers, of New York, built the *America* yacht, which proved to be a very fast one. This gained him reputation and friends, and secured him orders for constructing various other vessels of larger sizes. He succeeded in building more than one fast and serviceable commercial steamship, and when the American gov-

ernment resolved upon making a demonstration with large steamships of war, Mr. Steers, or the friends of Mr. Steers, succeeded in getting the design and construction of one committed to him. Mr. Steers knew but little, if anything, practically of ships of war; and, if we are rightly informed, cared to know but little of them, except what the light of nature supplied him with, for, we are told, he availed himself but very little of the freedom with which he was permitted to have access to the Bureau of Construction and all that it contained. More than one professional American gentleman has spoken to us strongly upon this point. "It was but reasonable," says the United States *Nautical Magazine*, "to suppose that every facility would be afforded Mr. Steers, now that improvement seemed to be really intended, and, with the exception of the propelling power in the quantity of canvass, the ground tackle in the kind of anchors, and the ventilation in the improved side-lights he has thought proper to use, he has been allowed to exercise his own judgment, both in the model and manner of construction, and is, like the constructor of the *Ohio*, quite willing to take the whole measure of responsibility, having a full knowledge of its weight and bulk. This vessel, as her dimensions and calculations will show, is the largest of the six, and is also of a very different model and construction. In the construction of the *Niagara* it is alleged that there are principles involved which are of great importance to the safety of vessels, which have never been appreciated in the navy, either in this country or elsewhere. It was supposed that in the model and internal arrangements alone would this vessel differ from the other five vessels; but it is discoverable that not only is the form of the fabric and her arrangements in armanent different, but that the manner of distributing the materials throughout the vessel is also entirely different, utility being regarded as of more consequence than the time-honored precedents, the constructor having sought to secure the greatest amount of strength with the least bulk."

The principal dimensions of the *Niagara* are as follows:—

	ft.	ins.
Length on load-water line,	328	10
" over all,	345	0
Breadth extreme,	55	0
" moulded,	53	8
Depth of hold to spar deck,	51	3
Draft of water,	26	0

Her ports are fifteen feet above the load-water line. Her height between decks is 7 feet 3 inches to the under side of beams! Her displacement at 23 feet draft is 5440 tons. Her frame is of live oak, filled in below with yellow pine, and crossed on the *outside* with two sets of diagonal iron plates inclined in opposite directions. She is also strengthened forward by similar diagonal plates laid across the beams of the upper deck. Her plank of bottom and decks are of yellow pine. Having a very fine run, she is, of course, weak at her quarters, in consequence of which, Mr. Steers has fitted on each side a large 2-inch iron stay or brace, which lies along the upper deck beams, and passing through the decks below steps upon the stern post. This is certainly a curious arrangement for a ship of war. It may as well be added here, that when she is docked, it is thought necessary by Mr. Steers to brace her two sides together, at

about the turn of the bilge, by means of a chain, which passes over a frame or saddle, which is set up by wedges to tighten the chain.* She is rigged like the *Merrimac* and others.

The *Niagara* carries 12 guns, 5 of a side, and 2 pivot guns, each of them 11 inches in the bore, and weighing upwards of 7 tons. All the guns are mounted on pivoted carriages, and the broadside ports have consequently to be very large—9 feet long and 4 feet high. Through ports of this size the guns would be easily dismounted in close action; but the *Niagara* is intended to be fast, and, being furnished with long range guns, is supposed to have the power of annoying and injuring an enemy, while she herself keeps out of the range of her enemy's guns. She was, in fact, designed for the express purpose of giving the Americans the advantage over all existing ships; it is satisfactory, however, for us to know that in our dock-yards there are already several new class ships quite competent to match her, and, if we are not mistaken, to give a good account of Mr. Steer's experiment. We should be pleased to know with certainty that such a trial of strength is not likely to come off; we hope it never may.

The engines of the *Niagara*—designed by Mr. Copeland, and built by Pease & Murphy, New York—are similar to those of the *Merrimac*, but she has three cylinders, each 72 ins. diameter and 3 feet stroke, instead of two. Each frame for cylinders is cast in one piece; the cylinders have slide valves, and a separate cut-off or expansion slide valve adjustable so as to cut off at any point from three-eighths to five-eighths of the stroke. Each cylinder has its own separate condenser, air pump, and hot-well; in fact, there are three complete engines, so that, should either become deranged, the others would be still available. The screw propeller (formed of composition) is 18 feet 3 inches diameter and 4 feet 2 inches long, with pitch of 29½ feet (at the periphery). The boilers are four in number, 11½ feet long, 21 feet wide, and 15 feet high. Like those of the frigate, they are Mr. Martin's vertical tubular. They are set in pairs, the flues discharging into two chimneys.

In concluding these remarks we would refer our readers back to page 125 of our number for Aug. 9, (No. 1722), in which we published a very excellent (though not faultless) criticism upon the *Niagara*, extracted from the *Journal of the Franklin Institute*.

Bessemer's Improvements in making Malleable Iron, &c.†

In our September number we gave a report *in extenso* of the very interesting paper read by Mr. Bessemer, before Section G., at the Cheltenham meeting of the British Association, in which this important invention was, for the first time, announced to the public. We were also exclusively enabled to give an accurate report of the more interesting parts of the discussion, which followed the reading of the paper. We were also the first to give an illustrated description of the converting

* Notwithstanding these signs of anticipated weakness in the *Niagara*, it has been stated by a person who sighted her both in the stocks and subsequent to her launch, that she "broke" only one inch in her length. This is so extremely improbable that we almost think he must have sighted her *athwartships* instead of *fore and aft!*

† From the Lond. Artizan, Nov., 1856.

vessel and apparatus, as used by Mr. Bessemer; and to describe the experiments made at Baxter House, for the purpose of demonstrating the practicability of the process.

During the time intervening between the first public experiment, on the 22d of August, and the end of October, we have very frequently witnessed experiments variously made, for the purpose of testing the invention in every conceivable manner; and with but two or three exceptions (and these resulted from inadvertence or inattention), every demonstration was successful; and, notwithstanding all that those who are either adversely interested, or ignorant of the matter, may say, *the invention is in principle correct*, and all that Mr. Bessemer professed, he was able to do—in the way of converting, by one operation, the crude pig iron, into refined metal, fit for rolling and working into malleable iron—this he *is* able to do, and does unmistakably.

That greater experience is required in the management of the operation, is undeniable; but the very failures which have arisen from the deficiency in this respect, have proved the correctness of Mr. Bessemer's principle.

We have seen some of the *burnt iron* produced by accident, during an experiment, converted into *fine fibrous iron* rods and sheets, by re-heatings and workings.

The following is an account of experiments made under the superintendence of Messrs. Smith, Phillips & Co., the owners of the Dafen Tin Plate Works, Llanelly:—

In the first place, the firm furnished Mr. Bessemer with a mixture of different sorts of pig iron, such as are used by them for making their best charcoal bars. This was melted in the presence of one of the firm at Baxter House, and then run into the converting vessel, and in twenty-five minutes an ingot of soft malleable iron, 10 inches square, was produced. It was so soft, as when cut with a chisel, to have almost the appearance of lead. The charge of iron being insufficient to fill the mould, a thin crust was formed at the upper end of it, and so strong was it that it required considerable exertion with a heavy sledge hammer, before a small piece, about an eighth to a quarter of an inch thick, could be broken off. The 10-inch ingot being too large to be treated properly there, Mr. Bessemer had it hammered down at Woolwich into two ingots of about 4 and 5 inches square. It was evidently injured by this process, having been apparently overheated, for the two ingots broke easier than ordinary pig iron of the same size would do. This was very discouraging, but the firm determined to continue the trial. They began by heating part of an ingot in a hollow fire, and when it was at a white heat, it was reduced under a 30 hundred weight steam hammer to a slab, about 5 inches wide by 3 inches thick. This was again heated and rolled into a bar, half an inch thick, and a very wretched looking bar it is stated to have been, being deeply cracked all down one side. Much better bars have, however, since been made from part of the *same* ingot. So bad was it, that one of the firm thought it useless to proceed further with the experiment; but another member, nothing daunted, had it cut up into pieces of the usual length, and taken to the mill. It proved to be what is called in the trade, very cold short, and did not cut at all

well. Here, however, the difficulties ended, for it rolled beautifully into sheets, to the amazement of all who were present. The thinnest of the specimens sent (all of which were made from the unpromising looking bar above mentioned) is what is called "tagger" iron, and is unusually thin. At all events, none so thin have ever before been produced there, or at all approaching to it. It will be found, on bending it, that it is remarkably tough. The thicker piece of iron of the specimens sent, has not been annealed, and therefore is not so tough; but the same iron, annealed and finished as tin plate, stands what is considered a very severe test, namely, twice doubling without cracking. The firm have reason to believe it is fully equal to plates of the same substance made from their best charcoal iron.

This experiment, and others since made, lead to the belief that, if uniform results can be obtained from the converting vessel, and if the same quality pig iron is always used, there is every reason to believe that the invention will prove very valuable to tin plate makers, as there is clear proof that sheet iron of superior quality may be produced by adopting it.

The best way of working the large ingots into bars has yet to be learnt; but it is expected that the plan Mr. Bessemer recommends, of passing them through a series of rolls, will be found to answer perfectly. It may be mentioned that Messrs. Smith, Phillips & Co., tried a piece of the bar from which the specimens sent were rolled, in the blacksmith's shop. It proved to be very red, short, and difficult to work; so that some further improvement in the process is required before iron made by it can be brought into general use.

One of the disadvantages under which Mr. Bessemer labored in connexion with his experiment made at Baxter House was, that during the pouring of the molten metal from the converting vessel, after being refined, the air was carried into the mould with the metal, and produced very porous ingots.

To remedy this defect, which was of the greatest disadvantage in connexion with the steel or semi-steel produced by this process, Mr. Bessemer proposed a plan of pouring the metal, by means of a novel contrivance, in which the same principles were involved as in his converting vessel, except that the cold air is driven *on to* the surface of, instead of *into* the midst of, the fluid metal.

Mr. Bessemer, in specifying the patent for his invention, gives the following description of the very ingenious contrivance which he has superadded to his former apparatus, and of which we now give illustrations, kindly furnished to us by Mr. Bessemer. He says:—

In carrying this invention into practical operation, it is preferred to mount the refining vessel or chamber on axes not situated at or near the centre of gravity of the chamber, by which means the pouring out of its contents will be facilitated, and the spout kept in a proper position in reference to the mould during the time of pouring the fluid metal therein. The air may be introduced at the sides or ends of the vessel, through small holes formed in pieces of well-burnt fire-clay, so that by moving the chamber or vessel on its axis, the holes in the fire-clay may be made to descend beneath the surface of the metal, or be raised above it, as desired. It must be observed that the air or other gaseous matters,

must be compressed with a force greater than will balance the weight of a column of fluid metal of a height equal to the depth of immersion of the jets below the surface of the fluid metal.

The accompanying illustrations show the form of apparatus employed: Fig. 1 being an end elevation; Fig. 2 a cross section; and Fig. 3 a longitudinal section of the vessel or chamber. Fig. 2 shows the vessel half turned up, but in Figs. 1 and 3 it is shown in its lowest position. The tuyere pipes are also shown in detail at Figs. 4, 5, 6, 7, 8, and 9.

FIG. 1.

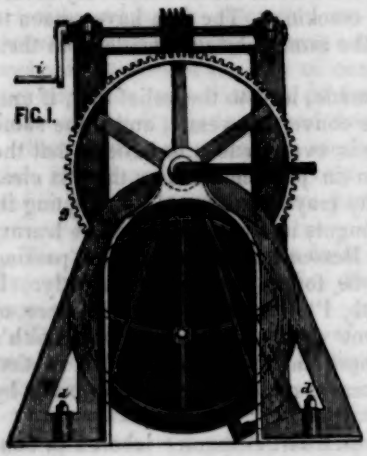
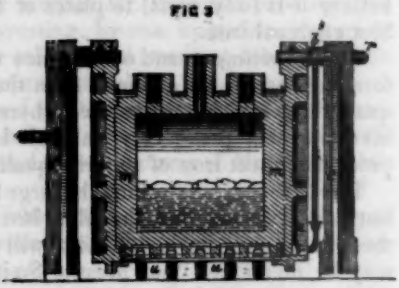


FIG 3



The cylindrical vessel *a* is formed of stout plate iron, secured by angle iron flanches, to the cast iron plates a^1, on which ribs or webs are formed, for the purpose of giving to them the requisite degree of strength. At

FIG 2

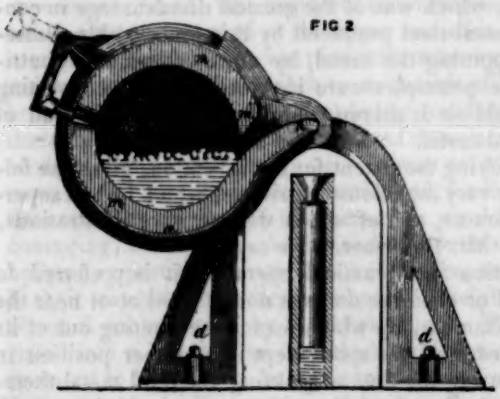


FIG 4

FIG 5

FIG 6

FIG 7

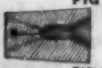


FIG 8

FIG 9

one side of the plates a^1, and at a point beyond their outer edges, bosses are formed: they are bored out truly and fitted and keyed to the axles *b*, and b^1, on which the converting vessel *a*, is made to move when required; *c*, *c*, are iron frames secured by bolts *d*, to the masonry founda-

tion, on which the whole apparatus rests; the frame c^1 rises higher than the others, and has plummer blocks, *e*, *e*, bolted to it, in which the shaft *f* revolves; a worm wheel *g* is keyed firmly on the axis *b*, and receives motion from the worm *h*, whenever the handle *i* and shaft *f* are moved round. The interior of the vessel *a* is lined with fire-bricks or fire-stone (as shown at *m*), or it may be lined with any other slow conductor of heat capable of withstanding the high temperature and solvent action of the slags, to which the lining is exposed when the vessel is in use; the bricks or fire-stone may, however, be protected and mended from time to time by moving either of the said plates a^1, which may again be bolted on to the vessel as soon as the new lining is completed, or a man-hole (not shown in the drawings), may be made in one side of the vessel, through which the lining or repairs may be effected without removing the end of the vessel. At *n* there is formed a projecting spout or lip, for the purpose of running out the fluid metal; this lip is made to project from the vessel so far as to bring it in a line with the axis, so that into whatever position the vessel *a* may be moved, the extremity of the lip *n* may retain the same position, or nearly so, and thus allow the stream of metal flowing over it, to fall into the ingot mould, which would not be the case if the axis were placed in a line with the centre of the cylindrical vessel; by reference to Fig. 2, it will be seen, that at m^1 the lining is formed so as to prevent the metal from carrying out with it the slags or other matters, floating on its surface, until after the metal has run out. On each side of the spout *n* (see Fig. 3), there is a curved passage *p*, by means of which the flame and gaseous products evolved during the process may escape, but the splashes of metal thrown up by the jets of air are for the most part prevented from escaping from the vessel by the serpentine form of these outlets. At *r* there is a pipe, which is made to communicate with a blast engine, or with a steam boiler, or it may be made to communicate with a reservoir containing oxygen gas, or a mixture of oxygen with other gaseous fluids, or with any gaseous matter capable of evolving oxygen, any or all of which may be used, either in a cold or heated state, although it is preferred to use atmospheric air at its natural temperature, on account of its cheapness and efficiency. The pipe *r* is fitted at one end of the trunnion or axis b^1, which is made hollow, and is provided with a stuffing-box or other joint, so as to allow the movement of the axis, without interfering with the passage of the air; through it the pipe *s* is also connected with the hollow axis b^1, and has a right angled elbow or bend at its opposite end, and then continues along the outside of the vessel throughout its whole length, and is turned truly on its exterior surface, and has fitted upon it several small branch pipes, *u*, each of which has a T-piece connected to them, which is bored out truly, and made to fit accurately to the exterior of the pipe *s*, so as to admit of the pipe *u* being moved on the pipe *s*, into the position shown by dots in Fig. 2. Along one side of the converting vessel there is a row of square holes, in which small blocks of well-burnt fire-clay are loosely fitted; they are held in position by ramming a little loam well into the joint formed between them and the lining *m*. At one end of these blocks or tuyeres the pipe *u* is fitted by a simple cone joint; the other ends of the tuyere-blocks have several small holes made in them

leading into one larger passage, which communicates with the pipe *u*, so that a communication is thus established between numerous points of the interior surface of the converting vessel and the blast-engine, or reservoir of gaseous matters before referred to, and by means of which numerous small jets, or currents of air, &c., may be forced into the converting vessel when required; a sluice-cock on the pipe *r* (not shown in the drawings), enabling the workmen to turn off the supply of air when required. In order that the way in which the pipe *s* and the pipe *u* are arranged may be better understood, a detached view of them is given at Figs. 5 and 6, where it will be seen that the pipe *s* has a hole in it at *x*, which is opposite the orifice of the pipe *u*. Through this hole the air may pass freely when the pipes *u* occupy their ordinary positions; but whenever any of the tuyere-blocks require renewing, the pipe *u* can be turned upon the joint formed at its union with the pipe *s*, as shown by dots in Fig. 2, and in which position the hole *x* in the pipe *s* will be closed, while free access to the tuyere is obtained. Also at Fig. 6 is shown an end view, and at Fig. 7 a longitudinal section of a tuyere-block, where *z*, *z*, show the small apertures through which the air escapes into the metal, all of which passages unite in the larger one *z*, the orifice of which is made conical, so as to fit the end of the pipes *u*. It has also been found that a single outlet in each tuyere-block will answer well in practice, as represented in end elevation at Fig. 8, and in longitudinal section at Fig. 9, where a single parallel passage *y* leads direct from the pipe *u*, into the metal. As these passages sometimes get obstructed, a screw plug *q* is fitted at the back of the elbow of the pipe *u*, which plug may be removed if required, while the apparatus is in use, and a steel rod introduced at the aperture, which should be thrust entirely through the tuyere-block, and any accidental accumulation of matter will be thus removed. By reference to Fig. 1, it will be seen that a boss *v* is formed at the point of junction of two of the webs which are formed on the end plates *a*, of the converting vessel; into this boss a stud is fixed, to which a chain or tension rod may be attached, for the purpose of suspending a counter-balance weight, the chain passing over a pulley, supported by the roof or other convenient part of the building, so that the vessel *a* may be the more easily moved on its axis, by means of the worm-wheel gearing before described.

Bessemer's process has been adopted at some of the largest iron works in England and Wales, and we have seen splendid specimens of iron, and articles made therefrom in numerous forms, from a 22 ft. long single-headed railway bar to batten and tagger plates, so thin that four thicknesses will pass readily into the No. 26 iron wire gauge, or of the thickness of a sheet of ordinary writing paper.

We shall again recur to the subject next month, when we hope to be able to give the results of some very important and practical workings on a large scale, which are now being made.

*The Atlantic Telegraph.**

"A wire six times the length of the Varna and Balaclava wire, if of the same lateral dimensions, would give thirty-six times the retardation and thirty-six times the slowness of action."

It was known, at the time that these words were placed on record by Prof. Thomson,† with direct reference to their practical bearing on the Atlantic project, that the action of the Black Sea Telegraph was inconveniently slow, and its utterance indistinct,—and it was not doubted either by myself or others who heard the above words, that Prof. Thomson meant to give them their full weight, in their literal and practical application.

I will not recapitulate what has been already published in your columns, further than to say that this public and confident avowal of an opinion so discouraging to the progress of submarine telegraphy urged me to a renewed investigation of the subject experimentally, and with the use of instruments of great delicacy and far more free from sources of error than those which I know to have been made use of in the Black Sea. It was upon this practical basis that I joined issue with Prof. Thomson, testing the application of his theory, as stated by himself, to the hard facts of practical telegraphic operations.

The result of my experiments, far from confirming this dictum, went in the opposite direction,—demonstrating, as clearly as such experiments could, the fallacy of this application of the law of the squares.

One or two letters have passed, and in this week's number of your paper I find that, though still maintaining the correctness of the theory —as theory, the whole position for which I originally contended, is conceded by Prof. Thomson. I cannot add to the force of his own words:— "It depends on the nature of the electric operation performed at one extremity of the wire, and on the nature of the test applied at the other extremity, whether or not any *approach to the law of the squares is to be expected* in the observed results," (the italics are his.)

We have then a table, "derived solely from theory," containing in horizontal lines eight series of retardations calculated for various distances and under various conditions of current. Of these, Prof. Thomson says, "Now it will be observed that the law of the squares is fulfilled throughout no horizontal line of the table, excepting the first and last." These two, I may be allowed to add, contain conditions utterly foreign to practical telegraphy:—the one requiring a contact with the battery "during $\frac{1}{12000}$ of a second or any less time,"—the other a contact of over 24 seconds duration. So that, according to Prof. Thomson's own table, in no telegraphic operation at distances ranging from 150 to 2400 miles can the retardation of signals be found in accordance with the sentence with which I commenced this letter.

I must confess it has surprised me that, with the acute powers of reasoning possessed by Prof. Thomson, he has never been led, by the very many "deviations from the law of the squares," and the "serious derangement of the results" which he recognises as arising from the inconstancy of the battery employed, to reason out, from these data, the

* From the Lond. Athenæum, Nov., 1856.

† Meeting of the British Association, Glasgow, Sept., 1855.

possibility of attaining, by a modification of the form of current employed, even with the same size of conducting wire, a much higher rate of propagation of the electric impulse, and a corresponding increased rapidity of utterance.

Instead of hopelessly endeavoring to make my results correspond with any established theory, I have been contented to prosecute repeated experiments in order that I might *learn* from them; and these facts I have learnt from them:—

First,—that the very "deviation from the law of the squares" do, if rightly understood, open to us a field of research, rich, promising, intensely interesting and practical.

Second,—that the rate of propagation of the electric impulse in submarine wires admits of variation, not merely as an error, but that it is under control, and is—other conditions remaining alike—dependent upon the nature of the electric operation performed to such an extent as to render the adoption of entirely new data necessary, as the basis of any calculations made for the purposes of submarine telegraphs.

Third,—that such data, to be available, should be obtained by the use of instruments either identical or strictly comparable with those that will afterwards be employed in the telegraphic use of the wire.

I may add, that, from my connexion with the Atlantic Telegraph Company, it has been my privilege, as well as my duty, already to commence such an inquiry, that I shall at all times be well pleased to show Prof. Thomson any of the results obtained, and to receive his opinion thereon; and, in my turn, to aid him in any experimental examination of the subject he may wish to make for his own satisfaction upon the Atlantic cable, when sufficiently advanced in its manufacture to admit of such experiments. I am, &c.,

WILDMAN WHITEHOUSE.

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*New Process for the Preparation of Ferrocyanide of Potassium.**

By RICHARD BRUNNQUELL.

This process depends on the conversion of ammonia into cyanide of ammonium by ignition with charcoal or carbonaceous matters; and its principal peculiarity consists in the conversion of the cyanide of ammonium thus produced into cyanide of potassium, representing ferrocyanide of potassium, in the humid way. The gas containing ammonia is therefore passed through tubes filled with charcoal and heated to redness; the ammonia is thus converted into cyanide of ammonium, and this into ferrocyanide of potassium by contact with aqueous solutions of potash and suitable iron compounds. The particular advantages of this method are the following:—

1. *The considerable loss of potash and the expense of its recovery are got rid of.*—The potashes are first dissolved in water, by which they are freed from the greater part of the foreign salts. The solution is then treated with a quantity of the cyanide sufficient to convert the greater part of it into ferrocyanide of potassium; this is allowed to crystallize, and the

* From the Lond. Chem. Gaz., No. 337.

mother-liquor employed without further preparation for the same purpose. Thus we get rid at once of the contamination with silica, &c., and of the necessity of bringing the dissolved potashes again into a solid form, which is of itself a cause of loss.

2. *It becomes possible to replace the potashes by soda, which is much cheaper.*—By the old processes this was often tried in vain, because from the difficult reduction of sodium, the formation of cyanide of sodium in the dry way does not take place so easily, and moreover ferrocyanide of sodium cannot easily be crystallized from such impure solutions as the mother-liquors. The first difficulty is entirely got rid of in its formation in the humid way, and the second may also be overcome, as the solutions are much purer. Ferrocyanide of sodium certainly does not form such beautiful crystals as ferrocyanide of potassium; but if it can be prepared more cheaply, it will certainly make its way into use, especially as 6 parts of it go as far as 7 of ferrocyanide of potassium, the equivalent of sodium being lower.

3. *Bones may be employed in this process*, their subsidiary product, bone charcoal, covering the cost of the bones and their carbonization, and they would, therefore, furnish the nitrogenous gases for nothing. The gases from the carbonization of bones, are just as rich in ammonia in proportion as those of most other raw materials; in proportion to their weight, however, bones furnish less ammonia and much less gas.

4. *It is possible to bring back into the manufacture that portion of the ammonia which escapes conversion into cyanogen*, and thus convert it also into cyanogen; the ammoniacal salts obtained as subsidiary products, may be converted into ferrocyanide of potassium, by mixing them with lime, and adding them to the raw material.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 15th, 1857.

John C. Cresson, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Regents of the University of the State of New York, and the Metropolitan Mechanic's Institute, Washington City, D. C.

Donations to the Library were presented from the Geological Society, the Statistical Society, and the Commissioners of Patents, London; The Ecole Imperiale des Mines, Paris; M. L. A. H. Latour, N. P., Montreal, C. E.; John W. Harris, Esq., Rocheport, Missouri; Hon. Job R. Tyson, United States Congress; The Kentucky Mechanic's Institute, Louisville, Ky.; The Massachusetts Charitable Mechanic's Institute, Boston, Mass.; Charles B. Penrose, Esq., Pennsylvania Legislature.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of receipts and payments for the month of December, also his annual statement for 1856.

The Board of Managers and Standing Committees reported their minutes.

The Annual Report of the Committee on Publications was read.

Candidates for membership in the Institute, (8,) were proposed, and the candidates proposed at the last meeting, (142,) were duly elected.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen duly elected:—

John C. Cresson, President.

John Agnew, Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,	Owen Evans,	George Erety,
Thomas Fletcher,	Alan Wood,	Evans Rogers,
Abraham Miller,	John E. Addicks,	Robert Cornelius,
John C. Trautwine,	Isaac S. Williams,	Lawrence Johnson,
John H. Towne,	George W. Conarroe	George C. Howard,
Edwin Greble,	Thos. J. Weygandt,	Jacob Weaver,
David S. Brown,	Joseph J. Barras,	William Sellers,
Thomas S. Stewart,	Joseph Harrison, Jr.,	James H. Bryson.

AUDITORS.

Samuel Mason, James H. Cresson,
Samuel B. Finch.

At a meeting of the Board of Managers, held January 21st, 1857, the following officers were elected for the ensuing year:

Thomas J. Weygandt, Chairman.

Isaac S. Williams, Owen Evans, } Curators.

BIBLIOGRAPHICAL NOTICES.

Hand Book of Inorganic Chemistry. By Wm. Gregory; Fourth American from the third English edition; to which is added the *Physics of Chemistry.* By J. Milton Sanders, M. D., New York: A. S. Barnes & Co. 1857. 8vo. pp. 421.

Hand Book of Organic Chemistry. By Wm. Gregory, M. D.; Fourth American from the fourth London edition. Edited by J. Milton Sanders, M. D., New York: Barnes, 1857. 8vo. pp. 481.

There is probably no branch of Physical Science upon which it is at the present time more difficult to write a satisfactory treatise, than chemistry. The beautiful simplicity of the theories established by Lavoisier

and his contemporaries has long since disappeared, under the accumulation of facts heaped up by the multitude of observers whom the beauty of the subject and its practical importance have attracted; and the sad error of attempting to alter the nomenclature to suit each varying hypothesis, has led to difficulty in even reading understandingly the works of the modern theorists. The ancient Assyrians are said to have had some dozen forms for each of the letters of their alphabet, and it appears as though the student of chemistry in the next century would be obliged to remember about as many formulæ for the substances most familiar to him. In consequence of these difficulties, modern works on chemistry generally divide themselves into two classes: one of which, are devoted to general theoretical speculations, and discuss the facts only as they have a bearing upon the views which are propounded; while the other, devoted rather to practical utility, are intended to serve as a reservoir for the facts, and regard theory only as a means of classification by which these facts may be remembered. The science wants another Lavoisier to recombine these conflicting elements, but no such has as yet indicated his coming; chemistry is still in its essence an empirical science, and so many plausible hypotheses may be suggested to account for its phenomena, while so little of absolute demonstration is applicable to its theories, that authority is generally more available than argument, in settling belief, and simplicity rather than certainty is the standard of excellence.

The names of the treatises now under our consideration, indicate that they belong to the second class, and are intended to present rather a mass of chemical facts conveniently arranged for reference, than an attempt at a true theory of the science. Viewed in this light, we regard Dr. Gregory's books as perhaps the most useful which have of late years issued from the English press; and as furnishing to the student, whose attention to chemistry is incidental to the prosecution of some other profession, the medical-man, the agriculturist, or the manufacturer, a very excellent compendium, in which he will find the most of the facts of value to him, and the views which will suggest to him their applications. It is comprehensive, lucid, terse and practical, and although not a substitute to the chemist for more elaborate treatises, such as those of Berzelius and others, will still always be valuable in the laboratory.

Of the labors of the American Editor we cannot speak so favorably. It might have been much worse, for he has shown industry; but it ought to have been better, for it indicates a want of judgment, and in many cases an ignorance of the latest and best authorities. Why quote Rumford's comparatively rough experiments, when we have so many more accurate determinations since; and why, while Regnault's tables are several times given, retain the number, 0.870, given by Delaroche and Berard, as the specific heat of vapor of water, after Regnault has shown that it is entirely inadmissible? or what confidence will a reader put in statements which he cannot verify, when he finds the following, which we quote from a page opened at random: "When water at the temperature of 39° Fah. is either heated or cooled, it expands regularly for the same number of degrees, either added or subtracted: *hence, when cooled to* 36°, *it rises to the same point as when heated to* 44°. *At* 32° *it stands at the*